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Subject Categories

Abstracts in this bibliography are grouped under the following categories.

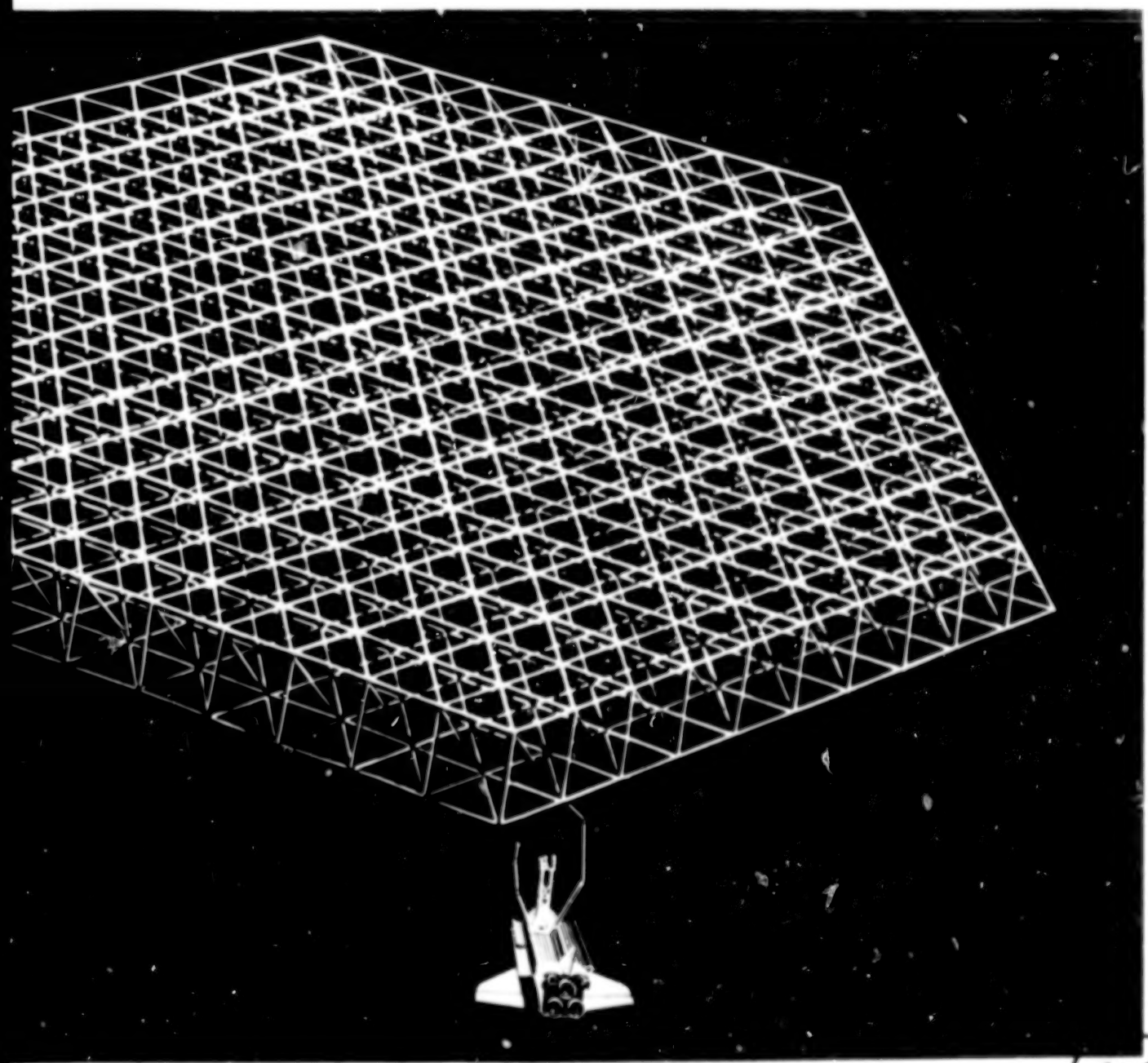
NASA

Technology for Large Space Systems

A Special Bibliography with Indexes

NASA SP-7046(11)
July 1979

National Aeronautics and Space Administration



NASA SP-7046(01)

TECHNOLOGY FOR LARGE SPACE SYSTEMS

A Special Bibliography
With Indexes

Supplement 1

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between January 1, 1979 and June 30, 1979.

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

NASA Scientific and Technical Information Branch 1979
National Aeronautics and Space Administration
Washington, DC

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INTRODUCTION

This special bibliography is designed to be helpful to the researcher and manager engaged in developing technology within the discipline areas of the Large Space Systems Technology (LSST) Program. Also, the designers of large space systems for approved missions (in the future) will utilize the technology described in the documents referenced herein.

This literature survey lists 180 reports, articles and other documents announced between January 1, 1979 and June 30, 1979 in *Scientific and Technical Aerospace Reports* (*STAR*) and *International Aerospace Abstracts* (*IAA*).

The coverage includes documents that define specific missions that will require large space structures to achieve their objectives. The methods of integrating advanced technology into system configurations and ascertaining the resulting capabilities is also addressed.

A wide range of structural concepts are identified. These include erectable structures which are earth fabricated and space assembled, deployable platforms and deployable antennas which are fabricated, assembled, and packaged on Earth with automatic deployment in space, and space fabricated structures which use pre-processed materials to build the structure in orbit.

The supportive technology that is necessary for full utilization of these concepts is also included. These technologies are identified as Interactive Analysis and Design, Control Systems, Electronics, Advanced Materials, Assembly Concepts, and Propulsion. Electronics is a very limited field in this bibliography, primarily addressing power and data distribution techniques.

The reader will not find references to material that has been designated as "limited" distribution or security classified material. These types of documents will be identified by the LSST Program Office, and a separate listing will be distributed to selected recipients.

This bibliography does not contain citations to documents dealing primarily with the Solar Power Satellite System (SPS). The SPS is a specialized subject such that if a bibliography is required it should be a separate publication.

A Flight Experiments category and a General category complete the list of subjects addressed by this document.

The selected items are grouped into ten categories as listed in the Table of Contents with notes regarding the scope of each category. These categories were especially selected for this publication and differ from those normally found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract where available. The citations and abstracts are reproduced exactly as they appeared originally in *STAR* and *IAA* including the original accession numbers from the respective announcement journals. This procedure accounts for the variation in citation appearance.

Under each of the ten categories, the entries are presented in one of two groups that appear in the following order:

1) *IAA* entries identified by accession number series A79-10,000 in ascending accession number order;
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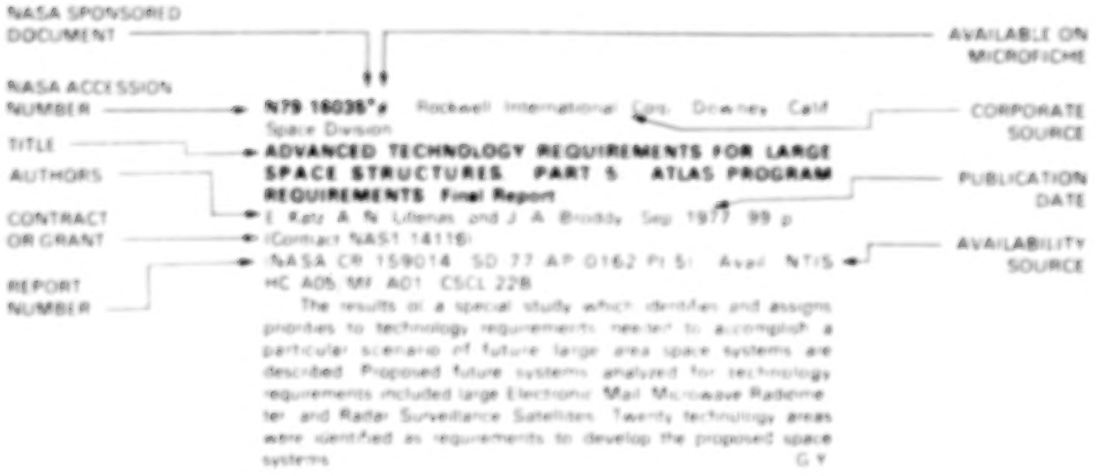

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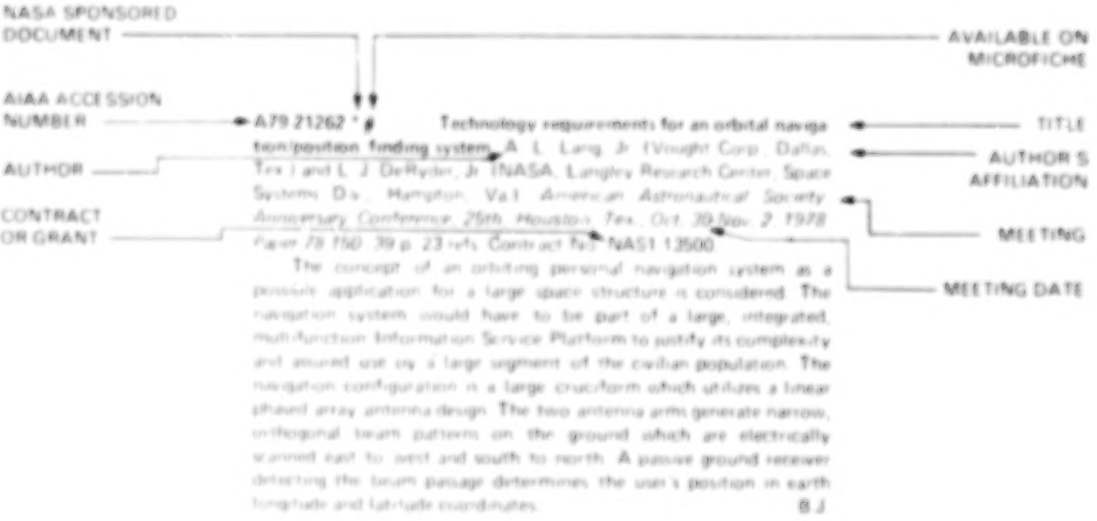

TECHNOLOGY FOR LARGE SPACE SYSTEMS *A Special Bibliography (Suppl. 1)*

JULY 1979

01 SYSTEMS

Includes mission requirements, focus missions, conceptual studies, technology planning, and systems integration.

A79-10510 * **Making a start on Shuttle-erectable structures.** E. Katz and D. L. Pankopf (Rockwell International Corp., Space Systems Group, Downey, Calif.). *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 40-43, 47.

Some general considerations on the design of Shuttle-erected structures are presented. It is noted that the design of such structures must be product of detailed integration of the assembly and load-carrying requirements. The assembly operations technology should be integrated with the ongoing structures technology. Early ground testing should evaluate the interface between structural element design, construction aids and tools, and assembly operations. Planning should begin on early flight experiments that can test the performances of the structure, assembly aids, crew, and operations in the zero-g environment. B.J.

A79-10511 * **Space platforms for building large space structures.** C. J. Goodwin (Grumman Aerospace Corp., Bethpage, N.Y.). *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 44-47.

The paper considers a mid-'80s beam-builder space platform with a moving cherry picker that could build structures too large for a single Shuttle sortie, but smaller than solar power satellites. The platform could have solar arrays, radiators, space construction equipment, and docking provisions. It would be a free flyer, placed into a low earth orbit readily accessible to the Shuttle. Docked to the Shuttle, the platform would enlarge the construction workspace, and add power and cooling to handle more demanding payloads and extend the Shuttle's on-orbit duration. As a free flyer, it could support experiments, laboratories, observation instruments, and even habitation modules. B.J.

A79-10512 * * **Technology assessment and outlook.** M. F. Card, E. T. Kruzewski, and A. Guastaferro (NASA, Langley Research Center, Hampton, Va.). *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 48-54.

The development of large space structures (LSS) for the 1980s is surveyed. Consideration is given to LSS mission requirements, large space antenna technology, several steps towards LSS development (1985-1995), structures technology needs (e.g., structural design criteria, assembly concepts, and practical joint and member concepts), structural dynamics/controls technology needs, and materials technology needs (e.g., accelerated test techniques and life prediction techniques). B.J.

A79-11216 **Roll-out solar arrays - Candidate power sources for future space missions.** J. Roth (Telefunken AG, Wedel, West Germany). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-39*. 22 p. 5 refs.

The development of solar arrays for future space missions is reviewed and the requirements for solar array power sources for such missions are discussed. Emphasis is placed on roll-out arrays, with application to future Shuttle missions. Attention is also given to cost and materials considerations, and development strategies and test philosophies for future power arrays. B.J.

A79-11277 **ARGUS SPAS - An experimental Shuttle-Pallet Satellite for earth observation.** D. Kinau (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-162*. 21 p.

The ARGUS SPAS is discussed as a passive, low-cost but powerful space platform optimized for a Shuttle launch into a low near-polar orbit. The satellite is conceived for European users' community requirements, in particular for high-resolution multi-spectral optical sensors, for powerful SAR instruments, and large passive microwave radiometers. Payload instruments tested and flown on Spacelab could be readily reused (or modified) on the proposed free-flying platform. V.P.

A79-11320 **The technology of large multi-function communication satellites in the post-Intelsat V era.** C. L. Cuccia (Ford Aerospace and Communications Corp., Palo Alto, Calif.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-262*. 15 p. 17 refs.

Characteristics, capabilities, technologies, and applications of large multifunction communication satellites are discussed. It is suggested that the use of multifunction satellites would reduce crowding by single-function satellites in the geostationary orbit. Concepts considered include the Cuccia rotating satellite, the Edelson-Morgan orbiting antenna farm, the Bekey satellite for personal communication, the Morrow packet switching system, the Reudink Yeh spin-beam satellite, the Jaffe-Fordyce switchboard in the sky, the Rosen-Jones giant spinner, and the Kaiello giant platform. The Intelsat position on orbiting antenna farms is reported. M.L.

A79-11338 **Comparative economics of very high capacity communications satellites for electronic mail transmission, educational TV distribution, and mass personal communications.** I. Bekey (Aerospace Corp., El Segundo, Calif.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-A-35*. 13 p.

The paper discusses the so-called complexity inversion technique, whereby increased satellite antenna size and power allows a reduction of size and power of the ground terminals. Three applications of this technique are described: electronic mail transmission, educational TV distribution, and personal radio telephone communication. The characteristics and economics of these three concepts are compared with that of terrestrial systems capable of providing the same level of service. It is shown that dramatic cost savings (or profits) are possible utilizing the advanced space concepts. B.J.

A79-11554 * **Advanced missions for X-ray astronomy in the Shuttle era.** H. Tananbaum and R. Giacconi (American Astronautical Society and Deutsche Gesellschaft für Luft- und Raumfahrt, God-

dard Memorial Symposium, 16th, Washington, D.C., Mar. 8-10, 1978. AAS Paper 78-008. 22 p. 18 refs.

During the next decade a number of advanced X-ray astronomy missions can be carried out using the Shuttle. In this paper we describe two such missions. One is the Advanced X-ray Astrophysics Facility (AXAF) which is envisioned as a 'permanent' national X-ray facility. The HEAO-B observatory is a forerunner of the AXAF. The second Shuttle mission which we describe is the LAMAR - Large Area Modular Array of Reflectors - which has been proposed as a survey experiment for Spacelab. (Author)

A79-11557 * **Serving the public via platforms in space.** R. Finlay and J. L. Bernstein (Grumman Aerospace Corp., Bethpage, N.Y.). *American Astronautical Society and Deutsche Gesellschaft für Luft- und Raumfahrt, Goddard Memorial Symposium, 16th, Washington, D.C., Mar. 8-10, 1978. AAS Paper 78-015.* 14 p. 13 refs.

The public service platform in geostationary orbit has the potential to benefit a large number of people. Some of these benefits include expansion of health and education services, emergency communications to disaster areas, and improved TV and voice communications to rural remote areas. This paper presents an overview of seven different platform concepts which have recently been studied. The public service functions that may be performed by each platform are identified. Artist's renditions of the overall platform configurations are shown together with the platform characteristics. Finally, mention is made of some of the major technological advances on which successful operation of public service platforms depend. (Author)

A79-11565 * **The space power module: Utility for Shuttle/Spacelab - tested for technology issues.** R. W. Johnson (Grumman Aerospace Corp., Bethpage, N.Y.). *American Astronautical Society and Deutsche Gesellschaft für Luft- und Raumfahrt, Goddard Memorial Symposium, 16th, Washington, D.C., Mar. 8-10, 1978. AAS Paper 78-047.* 9 p.

For a full utilization of the Space Shuttle, it will be necessary to increase the duration of the Shuttle orbit time. Additional power and thermal heat rejection capability will be needed for such an increase. An evolutionary growth program is urgently needed to describe each step necessary to provide the systematic implementation of a power heat rejection Shuttle augmentation system to lengthen orbit staytimes and to increase power for mission payload use. One approach considered involves the adoption of a modular 'plug-in' philosophy from the very beginning. Attention is given to the 25 kW Power Module program, the concept of a Space Power Technology Satellite, Space Power Technology Satellite operations, and an evolutionary path for extending the size of the power module heat rejection capability. G.R.

A79-13446 * **Repeater in the sky.** C. E. Cote and J. P. Brown (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: National Electronics Conference, Chicago, Ill., October 10-12, 1977, Proceedings. Volume 31. Oak Brook, Ill., National Engineering Consortium, Inc., 1977, p. 171-173.

The Public Service Communications Satellite (PSCS) program is intended to develop and demonstrate a space system aimed at stimulating future commercial markets in fixed and mobile applications. The services are envisioned for rural areas, regions beyond access to terrestrial systems, or for continuous cross-country applications. The system incorporates a UHF repeater for mobile voice and data experiments. 8 MHz of spectrum is specified for serving 70 channels. This paper describes the PSCS program and discusses some demonstration experiments. A future concept based on large structure multibeam antennas is also discussed. B.J.

A79-14090 * **Space payloads (Nutzlasten Raumfahrt).** A. Tegtmeier (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt and Hermann-Oberth-Gesellschaft, Deutscher Luft- und Raumfahrtkongress, Darmstadt, West Germany, Sept. 19-23, 1978. DGLR Paper 78-141.* 51 p. In German.

The paper gives a brief overview of the goals of space exploration missions, both manned and unmanned, for the 1990s, and considers the basic features of the main types of platforms and launchers envisaged for them. The concept of modularization of experiments is described. Brief descriptions of instruments planned for future scientific experiments in space are given. P.T.H.

A79-14902 * **Indefinitely extendable space radio telescopes. I - Scientific problems, composition and characteristics of arrays (Nesgranichenno narashchivaemye kosmicheskie radioteleskopy. I - Nauchnye zadachi, sostav i kharakteristiki kompleksa).** V. I. Burdakov, A. S. Gvamichava, L. A. Gorshkov, G. A. Dolgopolov, Iu. I. Gunilov, M. B. Zakson, N. S. Kardashev, V. V. Klimashin, V. I. Komarov, and N. P. Mel'nikov. *Kosmicheskie Issledovaniia*, vol. 16, Sept.-Oct. 1978, p. 767-777. 15 refs. In Russian.

The present paper reviews some concepts of the Cyclops project envisioned by NASA for an orbiting SETI system that would carry out its search from space, unhindered by radio interference from earth-based transmitters. The basic characteristics of enormous reflecting radio telescopes are discussed, and means of assembling such arrays in space are examined. V.P.

A79-20559 **Aerospace and military - Progress in space structure research, aircraft landing systems, integrated optics, and digital communications.** J. F. Mason. *IEEE Spectrum*, vol. 16, Jan. 1979, p. 71-75.

Progress in 1978 in aircraft landing systems, space structure research, military optical transmission and detection technology, and military digital communication systems are surveyed. Advantages of the MLS (microwave landing system), which will replace the ILS in the next decade are discussed together with data from Pioneer, Viking and Voyager spacecrafts which have radar mapped the planets Venus, Mars and Jupiter, respectively. The use of the Space Shuttle to erect space structures, including satellite solar-energy collectors, is analyzed, noting costs and size details. Attention is directed to design and advantages of fiber-optic links and of integrated optical circuits, techniques for developing a video-compression module, structure and advantages of a multifunctional radar (being tested by the Air Force) and of the AN/TTC-39 circuit and message system. A.A.

A79-20767 * **Planning for large construction projects in space.** J. H. Didner (NASA, Office of Space Flight, Washington, D.C.). In: Using space - Today and tomorrow. Proceedings of the Twenty-eighth International Astronautical Congress, Prague, Czechoslovakia, September 25-October 1, 1977. Volume 1. Oxford, Pergamon Press, Ltd., 1978, p. 79-123.

The paper discusses briefly some broad plans for developing the technology needed for large construction projects in space ranging from orbiting solar power stations to large communications antennas. Space construction classes include assembly of modules, deployment of compacted structures, assembly of passive performed pieces, and fabrication of structures from sheet stock. Technological areas related to structural concepts include (1) analysis for prediction of structural behavior, structural/control interaction, electromagnetic and control performance, and integrated design development; (2) electronics for signal conditioning and data acquisition, power distribution, and signal channel interference and multipaction; (3) concepts for shape control, attitude/pointing control, and orbital transfer and station keeping; and (4) materials and techniques for 30-year dimensional stable composites, thermal control, thin-lightweight structural alloys, and material joining in space. The concept of a power module for the construction operations is discussed along with a concept for a habitability module. P.T.H.

A79-21262 * **Technology requirements for an orbital navigation/position finding system.** A. L. Lang, Jr. (Vought Corp., Dallas, Tex.) and L. J. DeRyder, Jr. (NASA, Langley Research Center, Space

Systems Div., Hampton, Va.). *American Astronautical Society Annivesary Conference: 25th, Houston, Tex., Oct. 30-Nov. 2 1978 Paper 78-150.* 39 p. 23 refs. Contract No. NAS1-13500.

The concept of an orbiting personal navigation system as a possible application for a large space structure is considered. The navigation system would have to be part of a large, integrated, multifunction Information Service System to justify its complexity and assured use by a large segment of the civilian population. The navigation configuration is a large cruciform which utilizes a linear phased array antenna design. The basic antenna emits narrow, orthogonal beam patterns on the ground which are electrically scanned east to west and south to north. A passive ground receiver reflecting the beam pulse determines the user's position on earth longitude and latitude coordinates. B.J.

A79-23042 * Big Comsats for big jobs at low user cost. I. Bekey (NASA, Washington, D.C.; Aerospace Corp., El Segundo, Calif.). *Astronautics and Aeronautics*, vol. 17, Feb. 1979, p. 42-56.

Three examples are used to illustrate what is possible with large space systems: (1) personal communications using wrist telephones, (2) electronic transmission of mail, and (3) wide dissemination of educational TV. Design concepts and costs are explored and compared to alternative ground-based concepts. B.J.

A79-24450 Space will be the next big construction site. G. Bylinsky. *Fortune*, vol. 99, Feb. 26, 1979, p. 62-65, 68.

Further space construction is planned by NASA are described with particular attention to buffalo of antennas, called antenna farms, and solar-power satellites. An antenna farm will consist of a metal skeleton about 700 ft long, housing as many as thirty large dish antennas, accomodating up to five nationwide television channels, and serving almost 45,000 private channels handling calls from millions of pocket telephones. The projected solar-power satellites will be capable of feeding ten megawatts of electricity into its own antenna where it will be transformed into microwaves and beamed back to earth. The construction materials will be ferried by the Shuttle. A.A.

A79-25852 * Space reflector technology and its system implications. K. W. Billman, W. P. Gilbreath (NASA, Ames Research Center, Moffett Field, Calif.), and S. W. Bowen (Beam Engineering, Inc., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D.C., Feb. 6-8, 1979, Paper 79-0585.* 18 p. 18 refs.

The technical feasibility of providing nearly continuous solar energy to a world-distributed set of conversion sites by means of a system of orbiting, large-area, low areal-density reflecting structures is examined. Requisite mirror area to provide a chosen, year-averaged site intensity is shown. A modeled reflector structure, with suitable planarity and ability to meet operational torques and loads, is discussed. Typical spatial and temporal insolation profiles are presented. These determine the sizing of components and the output electric power from a baselined photovoltaic conversion system. Technical and economic challenges which, if met, would allow the system to provide a large fraction of future world energy needs at costs competitive to circa-1995 fossil and nuclear sources are discussed. (Author)

N79-10078*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LARGE SPACE SYSTEMS TECHNOLOGY, VOLUME 1
E. C. Naumann, comp. and A. Butterfield, comp. (GE Co.). 1978 540 p. Seminar held at Hampton, Va., 17-19 Jan. 1978 2 Vol.
(NASA-CP-2035-Vol-1; L-12068) Avail: NTIS HC A23/MF A01; CSCL 22B

Significant and/or controversial issues related to the design, packaging, transportation, deployment, erection, and on-orbit assembly of large space structures and related systems are addressed. Topics cover mission requirements, structural concepts, materials, structural alignment, thermal control, metrology, and technological forecasting.

N79-10079*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OVERVIEW OF THE LARGE SPACE SYSTEMS TECHNOLOGY PROGRAM
A. Guastaferro. *In its* Large Space Systems Technol., Vol. 1 1978 p. 1-17
Avail: NTIS HC A23/MF A01; CSCL 22B

A multicenter management approach which provides the opportunity to work across many disciplines and match the capabilities and expertise of various NASA facilities is described for the large space system technology (LSST) program which was established to define, develop, and verify structural concepts, analyses, and design procedures for a range of sizes and configurations to be deployed erected or fabricated in orbit during projected space missions utilizing shuttle in the 1985 to 2000 time period. Benefits from the program include reduced costs for transporting structures having low mass, high packagability, and multimission capabilities. Technologies identified by the LSST program will contribute to the solutions of problems in other sectors of the economy. A.R.H.

N79-10080*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TECHNOLOGY NEEDS AND OPPORTUNITIES FOR FUTURE NASA MISSIONS
S. R. Sadin. *In its* Large Space Systems Technol., Vol. 1 1978 p. 19-69
Avail: NTIS HC A23/MF A01; CSCL 22B

The process of forecasting NASA's future needs and missions as well as the technologies relevant to the projected requirements is examined with emphasis on large space system technology. A technology model (set of generic systems) is presented to assist in the development of technology program options, to identify major technology areas requiring concentrated effort, and to serve as an evaluation criteria for current technology programs. The model is applied to considerations of near and far term opportunities for exploration of the universe, global services, utilization of the space environment, and the space transportation system. A.R.H.

N79-10082*# McDonnell Douglas Astronautics Co., St. Louis, Mo.
DESIGNING STRUCTURES FOR LARGE SPACE SYSTEMS
R. H. Christensen. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 1 1978 p. 141-152
Avail: NTIS HC A23/MF A01; CSCL 22B

A questionnaire was compiled to identify technology deficiencies and point to research and development activities required in support of the large space structures program. Problem areas identified in setting criteria for such structures include improved flightworthiness, satisfying cost constraints, assessing new loads and environments, improved mission performance and life, and preservation of the ecology. A.R.H.

N79-10083*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ORBITING DEEP SPACE RELAY STATION (ODSRS): DSN FEASIBILITY STUDY REPORT
Tom Thornton and John Hunter. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 1 1978 p. 153-176
Avail: NTIS HC A23/MF A01; CSCL 22B

Future tracking requirements and advantages over earth based stations justify the design of an orbiting free flying very long base interferometry system to provide high resolution maps of celestial radio sources. Moderate technology development is required for the following: 30 meter to 60 meter diameter deployable parabolic antennas with less than 2 millimeters surface tolerance, a momentum wheel attitude control system

with few arc/second accuracy, solar power design, a hydrogen maser atomic frequency standard, and the cryogenic receivers. The system must meet current Deep Space tracking capabilities as a minimum, and the technology must be compatible with system performance growth in the future. System lifetime must be ten years without major refurbishing. A.R.H.

N79-10084*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HIGH RESOLUTION SOIL MOISTURE RADIOMETER
T. T. Wilheit. *In* NASA. Langley Res. Center Large Space Systems Technol. Vol. 1 1978 p 177-194

Avail: NTIS HC A23/MF A01 CSCL 22B

An electrically scanned pushbroom phased antenna array is described for a microwave radiometer which can provide agriculturally meaningful measurements of soil moisture. The antenna size of 100 meters at 1400 MHz or 230 meters at 611 MHz requires several shuttle launches and orbital assembly. Problems inherent to the size of the structure and specific instrument problems are discussed as well as the preliminary design. A.R.H.

N79-10089*# General Dynamics/Convair, San Diego, Calif.
APPLICATION OF GEO-TRUSS ERECTABLE ANTENNA 1985 - 2000 SYSTEMS
John A. Fager. *In* NASA. Langley Res. Center Large Space Systems Technol. Vol. 1 1978 p 335-367

Avail: NTIS HC A23/MF A01 CSCL 22B

The geo-truss concept provides a natural structural element to use in the deployment or fabrication of large systems. Three systems conceptually proposed and discussed are: (1) direct TV broadcast to half-time zone, Alaska and Hawaii; (2) deep space communication satellite; and (3) coastal water surveillance radar satellite. A.R.H.

N79-10095*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FUTURE LARGE SPACE SYSTEMS OPPORTUNITIES: A CASE FOR SPACE-TO-SPACE POWER?
L. B. Garrett and W. R. Hook. *In its* Large Space Systems Technol. Vol. 1 1978 p 507-531

Avail: NTIS HC A23/MF A01 CSCL 22B

Applications and options for beaming power to near-earth space users from a central space power platform are examined. The cost effectiveness of on-board versus remote power transfer is examined for orbital transfer propulsion systems. Performance characteristics are projected for advanced power generation, transmission, and receiver systems for the 1990's. Major technological development needs are identified with particular emphasis on large space systems technology. A.R.H.

N79-10097*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LARGE SPACE SYSTEMS TECHNOLOGY, VOLUME 2
E. C. Naumann, comp. and A. Butterfield, comp. 1978 505 p Seminar held at Hampton, Va., 17-19 Jan. 1978 2 Vol.
(NASA-CP-2035-Vol-2, L-12068-Vol-2) Avail: NTIS HC A22/MF A01 CSCL 22B

The proceedings of a seminar which was held to discuss the status of space technology and to plan the development of new technology for large space systems are presented.

N79-10102*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MSFC PRESENTATION CHARTS ON GEOSTATIONARY PLATFORM
William T. Carey, Jr. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 2 1978 p 683-705

Avail: NTIS HC A22/MF A01 CSCL 22B

A concept is presented of a geostationary platform. The concept takes the form of antennas and other payloads mounted on a strongback structure. The utilization and benefits of the platform are discussed. L.S.

N79-10112*# General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.
THE PRECISION SELF-METERING STRUCTURE (PSMS)
W. C. Yager. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 2 1978 p 1021-1055

Avail: NTIS HC A22/MF A01 CSCL 22B

Large, precise space systems such as space lasers, space telescopes, and space power transmitters cannot be realized until certain fundamental meteorological problems are first solved. It must be shown: (1) how a spatially distributed system of elements can be tied together in terms of a master coordinate system; (2) how master coordinates for these distributed elements can be determined with great accuracy; and (3) how mechanical integration of the elements to desired master coordinates of such accuracy can be achieved. Solutions to these problems are discussed. L.S.

N79-10124*# National Aeronautics and Space Administration, Washington, D. C.
OAST SYSTEM TECHNOLOGY PLANNING
Stanley R. Sadin. *In* NASA. Lewis Res. Center Future Orbital Power Systems Technol. Requirements Sep. 1978 p 17-39

Avail: NTIS HC A09/MF A01 CSCL 10A

The NASA Office of Aeronautics and Space Technology developed a planning model for space technology consisting of a space systems technology model, technology forecasts and technology surveys. The technology model describes candidate space missions through the year 2000 and identifies their technology requirements. The technology surveys and technology forecasts provide, respectively, data on the current status and estimates of the projected status of relevant technologies. These tools are used to further the understanding of the activities and resources required to ensure the timely development of technological capabilities. Technology forecasting in the areas of information systems, spacecraft systems, transportation systems, and power systems are discussed. G.Y.

N79-10131*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SOLAR ARRAY SYSTEMS
William L. Crabtree. *In* NASA. Lewis Res. Center Future Orbital Power Systems Technol. Requirements Sep. 1978 p 147-155

Avail: NTIS HC A09/MF A01 CSCL 10A

The recent past, present state-of-the-art, and future needs in the area of large photovoltaic solar arrays are discussed. In the past most attention was focused upon performance whereas in the future most of the effort should go into cost reduction. Suggestions are made regarding possible approaches to reducing cost such as on-orbit maintenance, extended lifetime, solar concentrators, and high-voltage modular concepts. G.Y.

N79-10970*# National Aeronautics and Space Administration, Washington, D. C.
ON THE PROBLEM OF CONSTRUCTING A MODERN, ECONOMIC RADIOTELESCOPE COMPLEX
A. F. Bogomolov, A. G. Sokolov, B. A. Poperechenko, and V. S. Polyak. Jun. 1977 23 p refs Transl. into ENGLISH from Antenny (USSR), v. 24, 1976 p 106-123 Original language doc. announced as A77-31614 Translated by Scientific Translation Service, Santa Barbara, Calif.
(NASA Order JE-654698)
(NASA-TM-75119) Avail: NTIS HC A02/MF A01 CSCL 03A

Criteria for comparing and planning the technical and economic characteristics of large parabolic reflector antenna

systems and other types used in radioastronomy and deep space communications are discussed. The experience gained in making and optimizing a series of highly efficient parabolic antennas in the USSR is reviewed. Several ways are indicated for further improving the complex characteristics of antennas similar to the original TNA-1500 64m radio telescope. The suggestions can be applied in planning the characteristics of radiotelescopes which are now being built, in particular, the TNA-8000 with a diameter of 128 m. A.R.H.

N79-15114*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 2: THEME SUMMARY. 1: SPACE POWER (NO. 7). A. THEME STATEMENT. B. 26 APRIL 1978 PRESENTATION. C. SUMMARY. D. INITIATIVE ACTION
1978 35 p refs Workshop held at Langley Station, Va., 26-30 Apr. 1976 17 Vol.
(NASA-TM-80002) Avail: NTIS HC A03/MF A01 CSCL 22A

A long-lived space-based system that converts on-orbit solar and/or nuclear energy to a suitable form for distribution to using space systems is described. Mission applications, requirements, issues, problems, benefits, and technology thrusts are identified for the multipurpose power platform. Power levels of at least 10-100Kw are required for space manufacturing, satellites, and space station operations. Two Mw are needed for a proposed passive radar system. Propulsion system requirements are in the 100Kw-100Mw range. A.R.H.

N79-15116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 2: THEME SUMMARY. 3: SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (NO. 9). A: THEME STATEMENT. B. 26 APRIL 1978 PRESENTATION. C. SUMMARY. D. NEWER INITIATIVES (FORM 4). E. INITIATIVE ACTIONS (FORM 5)
1978 72 p Workshop Held at Langley Station, Va., 26-30 Apr. 1976 7 Vol.
(NASA-TM-80004) Avail: NTIS HC A04/MF A01 CSCL 22A

Preliminary (1977-1983), intermediate (1982-1988), and long term (1989 +) phases of the search for extraterrestrial intelligence (SETI) program are examined as well as the benefits to be derived in radioastronomy and the problems to be surmounted in radio frequency interference. The priorities, intrinsic value, criteria, and strategy for the search are discussed for both terrestrial and lunar-based CYCLOPS and for a space SETI system located at lunar liberation point L4. New initiatives related to antenna independent technology, multichannel analyzers, and radio frequency interference shielding are listed. Projected SETI program costs are included. A.R.H.

N79-15118*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 2: THEME SUMMARY. 5: GLOBAL SERVICE (NO. 11). A. STATEMENT. B. 26 APRIL 1978 PRESENTATION. C. SUMMARY
1978 45 p Workshop held at Langley Station, Va., 26-30 Apr. 1976 17 Vol.
(NASA-TM-80006) Avail: NTIS HC A03/MF A01 CSCL 22A

The benefits to be obtained from cost-effective global observation of the earth, its environment, and its natural and man-made features are examined using typical spacecraft and missions which could enhance the benefits of space operations. The technology needs and areas of interest include: (1) a ten-fold increase in the dimensions of deployable and erectable structures to provide booms, antennas, and platforms for global sensor systems; (2) control and stabilization systems capable of pointing accuracies of 1 arc second or less to locate targets of interest and maintain platform or sensor orientation during operations; (3) a factor of five improvements in spacecraft power capacity to support payloads and supporting electronics; (4) auxiliary propulsion systems capable of 5 to 10 years on orbit operation; (5) multipurpose sensors; and (6) end-to-end data management and an information system configured to accept new components or concepts as they develop. A.R.H.

N79-15127*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OAST THEME WORKSHOP. VOLUME 3: WORKING GROUP SUMMARY. B: STRUCTURES, DYNAMICS (M 2). A. STATEMENT. B. TECHNOLOGY NEEDS (FORM 1). C. PRIORITY ASSESSMENTS (FORM 2)
1978 39 p Workshop held at Langley Station, Va., 26-30 Apr. 1976 17 Vol.
(NASA-TM-80015) Avail: NTIS HC A03/MF A01 CSCL 22A

A technology program on large space structures was defined to respond to common need perceived for five of the six themes. Greatly expanded power, facilities, and communications/sensing requirements appear to demand a new structures technology for construction in space. Requirements to construct huge structural arrays with precision surfaces in space will need creative research efforts to identify practical structural elements and construction techniques. Requirements for advanced transportation structures were defined to respond to the space transportation theme. Because of the criticality of thermal structures to achieve lower cost transportation systems, renewed emphasis on technology in this area is recommended. A second technology needing renewed emphasis is the area of recovery and landing technology structures to permit full reuse of launch vehicle propulsion elements. A.R.H.

N79-15222*# Future Systems, Inc., Gaithersburg, Md.
SATELLITES: A SYSTEMS COMPARISON Monthly Progress Report
18 Oct. 1978 39 p
(Contract NASw-3212)
(NASA-CR-158003; MPR-1; FSI-221) Avail: NTIS HC A03/MF A01 CSCL 17B

The advantages of using geostationary platforms as a means of accommodating future missions and payloads in lieu of individual, smaller satellites are reviewed. The cost effectiveness of large capacity communications platforms with separate smaller satellites on a systems basis considering total costs to the end user is assessed. For two specific systems, a system to provide communications for U.S. domestic applications and a system to serve the Atlantic INTELSAT requirements. These simple platform applications were selected because they minimize associated institutional problems. Although they do not exploit the full advantages that can ultimately be obtained from large platforms with multidiscipline missions, to the extent that these simple platforms demonstrate cost benefits, such benefits can be further enhanced by the addition of other payloads to the platforms. A.R.H.

N79-16035*# Rockwell International Corp., Downey, Calif. Space Division.
ADVANCED TECHNOLOGY REQUIREMENTS FOR LARGE SPACE STRUCTURES. PART 5: ATLAS PROGRAM REQUIREMENTS Final Report
E. Katz, A. N. Lillenas, and J. A. Broddy Sep. 1977 99 p
(Contract NAS1-14116)
(NASA-CR-159014; SD-77-AP-0162 Pt-5) Avail: NTIS HC A05/MF A01 CSCL 22B

The results of a special study which identifies and assigns priorities to technology requirements needed to accomplish a particular scenario of future large area space systems are described. Proposed future systems analyzed for technology requirements included large Electronic Mail, Microwave Radiometer, and Radar Surveillance Satellites. Twenty technology areas were identified as requirements to develop the proposed space systems. G.Y.

N79-17887*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

THE 25 kW POWER MODULE EVOLUTION STUDY. PART 1: PAYLOAD REQUIREMENTS AND GROWTH SCENARIOS Final Report
1 Aug 1978 211 p refs
(Contract NAS8-32928)
(NASA-CR-161143; LMSC-D614921-A-Pt-1) Avail NTIS HC A10/MF A01 CSCL 22B

Payload power level requirements and their general impact on the baseline and growth versions of the 25 kW power module during the 1983 to 1990 period are discussed. Extended duration Orbiter sortie flight, supported by a power module with increased payload power requirements per flight, and free-flyer payload missions are included. Other payload disciplines considered, but not emphasized for the 1983 to 1986 period include astrophysics/astronomy, earth observations, solar power satellite, and life sciences. Of these, only the solar power satellite is a prime driver for the power module. A R H

N79-17888*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE 25 kW POWER MODULE EVOLUTION STUDY. PART 2: PAYLOAD SUPPORTS SYSTEM EVOLUTION Final Report
30 Sep 1978 307 p refs
(Contract NAS8-32928)
(NASA-CR-161144; LMSC-D614928-Pt-2) Avail NTIS HC A14/MF A01 CSCL 22B

The addition of system elements for the 25 kW power module and logical evolutionary paths, by discrete growth stages, to provide capability for accommodating the increasing mission requirements through the early 1990's within reasonable resources are conceptualized. A R H

N79-18158*# Pennsylvania Univ., Philadelphia. Valley Forge Research Center.
STUDY OF LARGE ADAPTIVE ARRAYS FOR SPACE TECHNOLOGY APPLICATIONS Final Report, 27 Apr. 1976 - 26 Apr. 1977
Raymond S. Berkowitz, B. Steinberg, E. Powers, and T. Lim Jun. 1977 107 p refs
(Contract NAS5-23479)
(NASA-CR-152593; VFRC-112) Avail NTIS HC A06/MF A01 CSCL 20N

The research in large adaptive antenna arrays for space technology applications is reported. Specifically two tasks were considered. The first was a system design study for accurate determination of the positions and the frequencies of sources radiating from the earth's surface that could be used for the rapid location of people or vehicles in distress. This system design study led to a nonrigid array about 8 km in size with means for locating the array element positions, receiving signals from the earth and determining the source locations and frequencies of the transmitting sources. It is concluded that this system design is feasible, and satisfies the desired objectives. The second task was an experiment to determine the largest earthbound array which could simulate a spaceborne experiment. It was determined that an 800 ft array would perform indistinguishably in both locations and it is estimated that one several times larger also would serve satisfactorily. In addition the power density spectrum of the phase difference fluctuations across a large array was measured. It was found that the spectrum falls off approximately as f to the minus 5/2 power. F O S

02
INTERACTIVE ANALYSIS AND DESIGN

Includes computerized technology design and development programs, dynamic analysis techniques, thermal modeling, and math modeling

A79-11298 **New design verification aspects of large flexible solar arrays.** K. J. Zimmermann (Aerospace Engineering Office, Zurich, Switzerland). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-217*. 11 p. 7 refs.

The proposed design verification approach for studying large flexible solar arrays (1) starts testing at component level and follows the hardware assembly tree, (2) makes intensive use of structural optimization methods for the update of the mathematical model based on the test results, and (3) might reduce design verification cost while improving the accuracy in the analytical prediction. The verification approach is examined with respect to a study which analyzes, tests, and updates the mathematical model of a flexible blanket section of the CTS solar array. Characteristics and uses of large flexible solar arrays are considered. M.L.

A79-11299 * **Random motion analysis of flexible satellite structures.** T. C. Huang (Wisconsin, University, Madison, Wis.) and A. Das (General Electric Co., Space Div., Philadelphia, Pa.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-218*. 15 p. 18 refs. Contract No. NAS5-21798.

A singular perturbation formulation is used to study the responses of a flexible satellite when random measurement errors can occur. The random variables, at different instants of time, are assumed to be uncorrelated. Procedures for obtaining maxima and minima are described, and a variation of the linear method is developed for the formal solution of the two-point boundary-value problems represented by the variational equations. Random and deterministic solutions for the structural position coordinates are studied, and an analytic algorithm for treating the force equation of motion is developed. Since the random system indicated by the variational equation will always be asymptotically unstable, any analysis of stability must be based on the deterministic system. M.L.

A79-12422 **An optimality criteria method based on slack variables concept for large scale structural optimization.** S. A. Segenreich, J. Herskovits (Rio de Janeiro, Universidade Federal, Rio de Janeiro, Brazil), and N. A. Zouain. In: Symposium on Applications of Computer Methods in Engineering, Los Angeles, Calif., August 23-26, 1977, Proceedings. Volume 1. Los Angeles, University of Southern California, 1978, p. 563-572. 13 refs. Conselho Nacional de Desenvolvimento Científico e Tecnológico Contract No. 2222.0750/76.

The described nonlinear optimization method for large-scale structural optimization uses slack variables in order to transform inequality constraints into equality constraints. The method is applied to the determination of the Kuhn-Tucker multipliers which appear, either in an explicit or an implicit form, in recursion formulas. The theory and derivation of the basic design algorithm are presented. M.L.

A79-15736 **Mathematical modeling and simulation of the Space Shuttle imaging radar antennas.** R. W. Campbell, K. E. Melick, and E. L. Coffey, III (New Mexico State University, Las Cruces, N. Mex.). In: Synthetic Aperture Radar Technology Conference, Las Cruces, N. Mex., March 8-10, 1978, Proceedings. Las Cruces, N. Mex., New Mexico State University, 1978, p. IV-4-1 to IV-4-14.

Simulations of Space Shuttle synthetic aperture radar antennas under the influence of space environmental conditions have been carried out at L, C, and X-band. Mathematical difficulties in modeling large, nonplanar array antennas are discussed, and an approximate modeling technique is presented. Results for several antenna error conditions are illustrated in far-field profile patterns, earth surface footprint contours, and summary graphs. (Author)

A79-21495 **Dynamics of flexible hybrid structures.** H. Bremer (Munchen, Technische Universitat, Munich, West Germany). *Journal of Guidance and Control*, vol. 2, Jan.-Feb. 1979, p. 86-88. 5 refs.

A formal method of obtaining the equations of motion of flexible hybrid structures, consisting of interconnected rigid and elastic bodies, is described. The model is described in terms of hybrid coordinates, i.e., Cardan angles, for the deviation of the undeformed system from a given reference frame and a deflection vector describing the elastic motion relative to the rigid body state. Eigenfunctions are calculated from the condition of the stationarity of the Rayleigh quotient. The analysis is applied to derive the equations of motion of the Large Space Telescope. P.T.H.

A79-22030 **The buckling of lattice columns with stochastic imperfections.** R. K. Miller (California, University, Santa Barbara, Calif.) and J. M. Hedgepeth (Astro Research Corp., Carpinteria, Calif.). *International Journal of Solids and Structures*, vol. 15, no. 1, 1979, p. 73-84. 10 refs.

An analysis is presented for determining the buckling load of triangular lattice columns with combined local and overall imperfections. For the case where the imperfections are deterministic and uniform, the nonlinear problem is solved in terms of quadratures. The resulting buckling loads are shown to compare favorably with the predictions of a straightforward single-term Ritz approximation. The Ritz approach is used to derive estimators for the mean and standard deviation of the buckling load for the situation where the local imperfections are stochastic. The resulting estimators are shown to be valid by comparing their results with those obtained by a Monte Carlo simulation. (Author)

A79-22955 **Future trends in nonlinear structural analysis.** B. O. Almroth, P. Stern, and F. A. Brogan (Lockheed Structures Laboratory, Palo Alto, Calif.). In: Trends in computerized structural analysis and synthesis. Proceedings of the Symposium, Washington, D.C., October 30-November 1, 1978. Oxford and Elmsford, N.Y., Pergamon Press, 1978, p. 369-374. 21 refs. Research supported by the Lockheed Missiles and Space Independent Research Program.

Because the efficiency of available solution procedures is highly case dependent, an optimally efficient computer program must contain a large number of options. The quality of structural analysis would be greatly improved if more efficient solution procedures were developed and introduced in a single computer code, along with a means of selecting automatically the procedure best suited for each particular case. In other words, there is a stringent need for an efficient and reliable 'black box type' nonlinear equation system solver. The main objective of the present paper is to point out some recently contrived ideas that are worthy of consideration for inclusion in such computer programs. Emphasis is placed on three basic topics: solution procedures for nonlinear equation systems, discretization procedures (i.e., element technology and the use of global functions for approximating the displacement field), and adaptive programming procedures, involving automatic choice of methods and of time and load steps. V.P.

A79-25914 * **Dynamic model verification of large structural systems.** L. T. Lee and T. K. Hasselman (J. H. Wiggins Co., Redondo

Beach, Calif.), *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif., Nov. 27-30, 1978, Paper 781047*. 17 p. 7 refs. Contract No. NAS8-31950.

The objective of the present methodology is two-fold: (1) to process test data obtained from either modal survey tests, or slow sine-sweep tests, to extract a set of orthogonal modes best matching the test data while being commensurate with the dynamic model, and (2) to modify submatrices of the dynamic model mass and stiffness matrices to adjust the model to best fit the test data. The method has been implemented using a linear statistical sequential estimator for computation on a CDC computer. Demonstration problems involving Space Shuttle quarter-scale vibration test data and dynamic models have been run. This paper will discuss the general methodology and experience to date. (Author)

N79-10104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SYSTEM DYNAMICS AND SIMULATION OF LSS
R. F. Ryan. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 2 1978 p 751-774

Avail: NTIS HC A22/MF A01 CSCL 22B

Large Space Structures have many unique problems arising from mission objectives and the resulting configuration. Inherent in these configurations is a strong coupling among several of the designing disciplines. In particular, the coupling between structural dynamics and control is a key design consideration. The solution to these interactive problems requires efficient and accurate analysis, simulation and test techniques, and properly planned and conducted design trade studies. The discussion presented deals with these subjects and concludes with a brief look at some NASA capabilities which can support these technology studies. L.S.

N79-10116*# McDonnell-Douglas Astronautics Co., Houston, Tex.
REMOTE MANIPULATOR SYSTEM FLEXIBILITY ANALYSIS PROGRAM: MISSION PLANNING, MISSION ANALYSIS, AND SOFTWARE FORMULATION
L. Kumar 10 Aug. 1978 50 p refs
(Contract NAS9-15550)
(NASA-CR-151830; Paper-14-7.245) Avail: NTIS HC A03/MF A01 CSCL 22A

A computer program is described for calculating the flexibility coefficients as arm design changes are made for the remote manipulator system. The coefficients obtained are required as input for a second program which reduces the number of payload deployment and retrieval system simulation runs required to simulate the various remote manipulator system maneuvers. The second program calculates end effector flexibility and joint flexibility terms for the torque model of each joint for any arbitrary configurations. The listing of both programs is included in the appendix. A.R.H.

N79-13403*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BUCKLING TESTS OF STRUCTURAL ELEMENTS APPLI- CABLE TO LARGE ERECTABLE SPACE TRUSSES
W. L. Heard, Jr., H. G. Bush, and Nancy Agranoff Oct. 61 p refs
(NASA-TM-78628) Avail: NTIS HC A04/MF A01 CSCL 20K

Detailed data on columns and center a joint for completeness is presented. Buckling data for a tripod arrangement of these columns using a cluster joint is also presented. The objectives of these test are: (1) to gain insight into joint requirements for truss structure; (2) to assess the structural qualities of the column and center joint designs; (3) to investigate the restraint provided by octetruss core members (tripod) to the cluster joints; (4) to provide insight into the level of analysis required to predict buckling behavior of Gr/E nestable columns both as simple columns and in a tripod arrangement; and (5) to provide a data base for Gr/E nestable columns. G.Y.

03
STRUCTURAL CONCEPTS

Includes erectable structures (joints, struts, and columns); deployable platforms and booms; solar sail; deployable reflectors; space fabrication techniques and protrusion processing.

A79-10482 * **The utilization of welded variable-geometry structures in space erectable systems (O primenenii svarnykh preobrazuemykh konstruktsii dlia kosmicheskikh sistem i sooruzhenii).** B. E. Paton, V. M. Balitskii, V. N. Bernadskii, and V. N. Semilov. In: Manufacturing and behavior of materials in space. Moscow, Izdatel'stvo Nauka, 1978, p. 29-36. 11 refs. In Russian.

The paper considers the potential applicability of welded variable-geometry metallic shells in the assembly of large space structures. Initially in a folded or collapsed form easy to transport, the shells are easily 'transformable' into a form suitable for space assembly. Consideration is given to biconical, parabolic, and toroidal shells. B.J.

A79-10507 * **Automated fabrication of large space structures.** D. J. Powell and L. Browning (General Dynamics Corp., Convair Div., San Diego, Calif.). *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 24-29.

In the Space Construction Automated Fabrication Experiment (SCAFE), fabrication and assembly systems and prepackaged raw materials would be delivered by Shuttle to a 556-km, 28.5-deg circular orbit. Fabrication equipment would be deployed from the stowed position, and then a beam builder, moving to successive positions along a Shuttle-attached jig, would automatically make four 200-m-long triangular beams. Descriptions are presented of a typical beam assembly, cap and cross-member characteristics, open-cap stability, and the beam-builder and beam-welder concepts. B.J.

A79-10508 * * **Practical design of low-cost large space structures.** J. M. Hedgepeth (Astro Research Corp., Carpinteria, Calif.), M. M. Mikulas, Jr. (NASA, Langley Research Center, Hampton, Va.), and R. H. MacNeal (MacNeal-Schwendler Corp., Los Angeles, Calif.). *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 30-34.

The practical design of low-cost space structures involves the use of approaches that reduce the cost of the design and development effort itself. Such approaches include: (1) design with criteria arrived at rationally; (2) design for simplicity, repeatability, and modularity; (3) assembly without adjustments; (4) design for testability on the ground; (5) the attainment of structural efficiency by configuration and material choice rather than by squeezing down on the design margins; and (6) prefabrication and preassembly before launch. Attention is given to truss platform designs, and the Seasat Extendible Support Structure is discussed as a particular example. B.J.

A79-10513 * **Structures for solar power satellites.** R. H. Nansen and H. di Ramio (Boeing Aerospace Co., Seattle, Wash.). *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 55-59.

The paper compares tapered-tube and continuous-chord construction concepts for the baseline photovoltaic planar array of a solar power satellite. Both concepts appear to be feasible and could potentially be incorporated into an SPS design. The tapered tube has the advantage of less mass per SPS, higher manufacturing rate, easier structural-integrity verification, and more structural-design flexibility. The continuous chord has the advantages of higher packaging density if manufactured in space, less joint slop, and lower machine complexity. B.J.

A79-11173 **Electrostatically controlled wire-mesh antenna.** J. H. Lang, J. R. Gersh, and D. H. Staelin (MIT, Cambridge, Mass.). *Electronics Letters*, vol. 14, Sept. 28, 1978, p. 655, 656. 6 refs. Research supported by the Fannie and John Hertz Foundation; Grant No. DAAG29-78-C-0020.

A satellite antenna concept is described that permits large-diameter reflectors to be deployed from a single Space Shuttle payload by using the lightest available reflecting surface. Antenna diameters up to one kilometer are sought for a wire-mesh reflector stretched across a hoop and distended electrostatically into parabolic shape. (Author)

A79-11288 **On-orbit fabrication and assembly of large space structural subsystems.** J. F. Garibotti, A. J. Caverley, Jr., and R. Johnson, Jr. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-192*. 14 p. 8 refs.

Future large space systems are examined with respect to on-orbit fabrication, and the role, design, and testing of generic structures are considered. The feasibility of on-orbit fabrication of a selected generic structure, a tetrahedral truss, is indicated, and preliminary planning for integration of a beam machine and associated fabrication equipment with the Orbiter is reported. The development of large structural subsystems and their evaluation are discussed. M.L.

A79-11912 **On the design of self-deploying, extremely large parabolic antennas and arrays.** A. A. Woods, Jr. and W. D. Wade (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Mechanical Engineering in Radar Symposium, Arlington, Va., November 8-10, 1977, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1977, p. 75-79.

A design solution for a large aperture space antenna is presented. This solution is a self-deployable antenna within state-of-the-art technology. This design is being proven in independent research and development work conducted at Lockheed Missiles and Space Company, Inc., (LMSC). The antenna described in this paper is compatible with Space Shuttle and usable at sizes up to 2000 feet in diameter for parabolic antennas and phased arrays. The availability of an antenna of this size removes a significant technology development activity, space assembly and manufacturing, as a stumbling block for space systems requiring extremely large aperture antennas. (Author)

A79-14055 * **The development of satellite antenna technology (Die Entwicklung der Satelliten-Antennentechnik).** B. Liesenkötter (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt and Hermann-Oberth-Gesellschaft, Deutscher Luft- und Raumfahrtkongress, Darmstadt, West Germany, Sept. 19-22, 1978, DGLR Paper 78-166*. 24 p. 19 refs. In German.

The use of directional antennas in information satellites and space probes is examined, and the antenna systems used in several satellites are described. The described antenna systems were used in Intelsat 1, Molniya 1, Venera, ATS 1, ATS 3, Helios, Intelsat 3, Intelsat 4, ATS 6, Intelsat 4A, Comstar, Intelsat 5, OTS, Voyager, and DSCS 3. Requirements for future antennas are considered, and it is suggested that antenna systems will become so complex that the satellite design will be determined by requirements associated with the antenna system. M.L.

A79-14056 * **Flexible roll-out solar generators - Energy sources for future high-power space missions (Flexible, rollbare Solargeneratoren - Energiequellen für zukünftige leistungsstarke Raumfahrtmissionen).** J. Rath (Telefunken AG, Wedel, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt and*

Hermann-Oberth-Gesellschaft, Deutscher Luft- und Raumfahrtkongress, Darmstadt, West Germany, Sept. 19-23, 1978, DGLR Paper 78-165. 22 p. 5 refs. In German. Research supported by the Bundesministerium fur Forschung und Technologie and European Space Agency.

The paper discusses the development of roll-out solar arrays for high-power (multi-kW or MW) space applications, with particular reference to the use of such arrays as power sources in Shuttle/Spacelab missions. The development of space power modules is described along with the use of roll-out arrays in satellite solar power stations. Cost considerations relating to the development of large arrays for the MW power range are discussed, and particular attention is given to large single-crystal (5 x 5 cm) and polycrystalline (5 x 5 cm to 10 x 10 cm) silicon solar cells. B.J.

A79-14902 * **Indefinitely extendable space radio telescopes. I - Scientific problems, composition and characteristics of arrays (Nizgranichenno rasshiriaemyi kosmicheskie radioteleskop. I - Nauchnye zadachi, sostav i kharakteristiki kompleksa).** V. I. Buidkas, A. S. Gvamichava, L. A. Gorshkov, G. A. Dorgopolov, Iu. I. Denisov, M. B. Zakson, N. S. Kardashev, V. V. Klimashin, V. I. Komarov, and N. P. Mel'nikov. *Kosmicheskie Issledovaniia*, vol. 16, Sept.-Oct. 1978, p. 767-777. 15 refs. In Russian.

The present paper reviews some concepts of the Cyclops project envisioned by NASA for an orbiting SETI system that would carry out its search from space, unhindered by radio interference from earth-based transmitters. The basic characteristics of enormous reflecting radio telescopes are discussed, and means of assembling such arrays in space are examined. V.P.

A79-17035 **Dynamic burst strain of composite cylinders - A novel test method.** R. W. Gooding, N. J. Parratt, K. D. Potter (Propellants, Explosives and Rocket Motor Establishment, Waltham Abbey, Essex, England), and B. Smith (Bristol Aerojet, Ltd., Banwell, Avon, England). In: ICCM-2: Proceedings of the Second International Conference on Composite Materials, Toronto, Canada, April 16-20, 1978. Warrendale, Pa., Metallurgical Society of AIME, 1978, p. 965-974.

A dynamic burst test procedure for polymeric composites used as ablating thermal insulants is described. The procedure is applied to some orthodox rigid insulants and to compositions which are normally more flexible. Preparation of the composite cylinders is explained, and the test results are compared with results from coupon tests. Percent strain results are presented for commercial asbestos-phenolic moldings. M.L.

A79-19616 * **Optimized design and fabrication processes for advanced composite spacecraft structures.** V. F. Mazzio and C. H. Bieler (General Electric Co., Space Div., Valley Forge, Pa.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0241.* 9 p.

This paper describes the design, fabrication and test of several lightweight graphite-epoxy and Gr-ep honeycomb composite structural sub-assemblies representative of spacecraft elements. The objective was to increase design and producibility data required to validate composites for more complex space structures. Design studies have shown that weight savings of 15 to 20 percent can be achieved through use of composite construction in primary and secondary spacecraft structures. Fabrication and bonding processes have been developed, which include the use of expansion tooling, to provide the weight savings and major cost savings in labor, tooling and cure time. Test results are planned to confirm predicted weight savings, and strength and stiffness capability. (Author)

N79-10085*# McDonnell Douglas Corp., St. Louis, Mo.
DESIGN CONSIDERATIONS FOR LARGE SPACE ANTENNAS
R. Johnson, Jr. *In:* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p. 195-219.

Avail: NTIS HC A23/MF A01; CSCL 22B

Performance requirements and costs for transportation, fabrication, and orbital assembly are the drivers in the design of large space antennas will range in size from approximately 30 m to 1 km in diameter and include radiometers, multibeam lens antennas, and microwave power transmission systems. Research and development is required to define comprehensive structural criteria for specific missions, to determine optimized geometries for truss elements and truss configurations and to establish requirements for joint design with consideration of tolerances, load transfer, thermal compatibility, and assembly and disassembly. Candidate structural elements, materials systems, for the low pressure rapid cure of advanced composite materials, and various on orbit assembly and fabrication techniques must also be developed. A.R.H.

N79-10086*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
LARGE ANTENNA STRUCTURE TECHNOLOGIES REQUIRED FOR 1985-2000
W. R. Wannlund. *In:* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p. 221-241.

Avail: NTIS HC A23/MF A01; CSCL 22B

Topics discussed include: (1) material degradation as related to graphite composites and thermal control coatings, (2) thermal distortions considering postulated end-of-life conditions for extended lifetime (over 10 years), (3) examination of built-in shape versus actively controlled surfaces, (4) testing philosophy of super large antenna structures, and (5) examination of some possibilities which may require new or different technology. A.R.H.

N79-10087*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
LARGE SPACE DEPLOYABLE ANTENNA SYSTEMS
In: NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p. 243-288.

Avail: NTIS HC A23/MF A01; CSCL 22B

The design technology is described for manufacturing a 20 m or larger space erectable antenna with high thermal stability, high dynamic stiffness, and minimum stowed size. The selected approach includes a wrap rib design with a cantilever beam basic element and graphite-epoxy composite lenticular cross section ribs. The rib configuration and powered type operated deploying mechanism are described and illustrated. Other features of the parabolic reflector discussed include weight and stowed diameter characteristics, structural dynamics characteristics, orbit thermal aperture limitations, and equivalent element and secondary ion axial patterns. A block diagram of the multiple beam pattern is also presented. A.R.H.

N79-10088*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON SPACE DEPLOYABLE ANTENNAS AND ELECTRONICS: PLANS AND PROGRAMS
T. G. Campbell, W. F. Croswell, T. Deaton, and B. Dobrotin (JPL). *In:* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p. 289-333.

Avail: NTIS HC A23/MF A01; CSCL 22B

Technology plans are presented for developing deployable reflectors having diameters of 30 to 300 meters and surface accuracies of several millimeters for L and X band applications, as well as for the electronic subsystems required for such large structures. An electromagnetic analysis method for predicting the radio frequency performance of large reflectors involves projecting field points onto an aperture plane. The data points in the aperture plane are quantized to produce contours of constant phase and amplitude. Far field patterns are then calculated using reduced computer storage. A.R.H.

N79-10090*# Space and Missile Systems Organization, Los Angeles Air Force Station, Calif.
USAF ANTENNA ON-ORBIT ASSEMBLY
Paul E. Heartquist *In* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p 369-401

Avail: NTIS HC A23/MF A01 CSCL 22B

Structural concepts, upper stage evaluations, and orbiter packing are discussed for spacecraft having 300 ft to 1000 ft diameter sensors. Techniques are examined for stowing, deploying, and transferring to high earth orbit expandable hex, expanding tetrahedral ring, and fold out truss configurations. Upper stage final candidate configurations and their influence on antenna design selection are discussed. A.R.H.

N79-10091*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
DEPLOYABLE ANTENNA DEMONSTRATION STUDY
Wilbur Thompson and Jack Schultz (Grumman Aerospace) *In* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p 403-429

(Contract NASB-32394)
Avail: NTIS HC A23/MF A01 CSCL 22B

A demonstration system and shuttle flight program was defined to demonstrate packaging, transportation, erection, and structural integrity of a large deployable antenna concept. An analysis of deployable antenna requirements indicates that (1) erectable structures are clearly applicable to very high precision (above 50 GHz) antennas (10 to 30 m), (2) deployable structures are light weight, applicable to moderate precision (below 14 GHz) large antennas (up to 300 m), and (3) both deployable and erectable apply to small and large antenna platforms with common utilities. A.R.H.

N79-10099*# Boeing Aerospace Co., Seattle, Wash.
STRUCTURAL/THERMAL CONSIDERATIONS FOR DESIGN OF LARGE SPACE PLATFORM STRUCTURES
D. L. Barclay, E. W. Brugren, and D. E. Skoumal *In* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 2, 1978, p 597-626

Avail: NTIS HC A22/MF A01 CSCL 22B

A method is described for placing a large, STS-compatible platform on orbit utilizing a construction method employing both deployable and erectable structures. A multifunctional mechanism is used for deployable structures and an on-orbit assembly is used for erectable structures. Also, analyses are discussed which assess the thermal distortion of a simple open truss and a more complex truss. L.S.

N79-10100*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
EFFICIENT CONCEPTS FOR LARGE ERECTABLE SPACE STRUCTURES
M. F. Card, H. G. Bush, W. L. Heard, Jr., and M. M. Maybee, Jr. *In its* Large Space Systems Technol., Vol. 2, 1978, p 627-656

Avail: NTIS HC A22/MF A01 CSCL 22B

The status of Langley Research Center development of the nestable column concept is reviewed including results of member and truss component tests, and planned assembly studies. In addition, more recent studies of alternative member concepts are presented. Preliminary results on relative efficiency of several types of truss-type columns are compared and future test plans discussed. L.S.

N79-10101*# General Dynamics/Convair, San Diego, Calif.
SPACE FABRICATION AND ASSEMBLY OF GRAPHITE COMPOSITE TRUSSES
D. J. Powell *In* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 2, 1978, p 657-681

(Contracts NASB-32471, NAS9-15310)
Avail: NTIS HC A22/MF A01 CSCL 22B

The structural and thermodynamic parameters of constructing and erecting graphite composite trusses in space are discussed. L.S.

N79-10103*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
GEOSTATIONARY PLATFORM STRUCTURAL SYSTEM
S. J. Denson *In* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 2, 1978, p 707-749

Avail: NTIS HC A22/MF A01 CSCL 22B

A discussion is presented on the following engineering considerations for a geostationary platform: (1) structural configuration and design, (2) thermal characteristics, (3) flight load considerations, and (4) assembly approaches. L.S.

N79-11272*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A REVIEW OF THE STATE OF THE ART IN LARGE SPACEBORNE ANTENNA TECHNOLOGY
C. A. Smith. 15 Nov. 1978. 64 p. refs.
(Contract NAS7-100)
(NASA-CR-157989; JPL-Pub-78-88) Avail: NTIS HC A04/MF A01 CSCL 20N

Three classes of antennas (reflectors, lenses, and arrays) are studied with a view toward their use as extremely large space antennas. RF performance characteristics, weight, manufacturing complexity, and cost are discussed for each class. Examples of antennas of each class which were built or analyzed are described to give an appreciation of current and expected industry capability. Multibeam antennas are discussed. General guidelines are given for use of the appropriate class of antenna to meet certain performance requirements, and recommendations are made for future study. The reflector emerges as the optimum choice for most very large aperture applications, though the lens and array appear ideally suited for use as feeds for multibeam near field Cassegrain or Gregorian designs. Author

N79-17079*# Grumman Aerospace Corp., Bethpage, N.Y.
DEPLOYABLE ANTENNA DEMONSTRATION PROJECT Final Report, 1 Jun. 1977 - 24 Mar. 1978
J. Schultz, J. Bernstein, G. Fischer, G. Jacobson, and R. Marshall. 24 Mar. 1978. 245 p. refs.
(Contract NASB-32394)
(NASA-CR-161096) Avail: NTIS HC A11/MF A01 CSCL 17B

Test program options are described for large lightweight deployable antennas for space communications, radar, and radiometry systems. Author

N79-17899*# General Dynamics/Convair, San Diego, Calif.
LARGE SPACE STRUCTURES FABRICATION EXPERIMENT Final Report
25 Jan. 1978. 165 p.
(Contract NASB-32471)
(NASA-CR-161098; CASD-ASP-77-021) Avail: NTIS HC A08/MF A01 CSCL 22B

The fabrication machine used for the pultrusion and on-orbit forming of graphite thermoplastic (GTP) strip material into structural sections is described. The basic process was analytically developed parallel with and integrated into the conceptual design of a flight experiment machine for producing a continuous triangular cross section truss. The machine and its associated ancillary equipment are mounted on a Space Lab pallet. Power, thermal control, and instrumentation connections are made during ground installation. Observation, monitoring, caution and warning, and control panels and displays are installed at the payload specialist station in the orbiter. The machine is primed before flight by initiation of beam forming to include attachment of the first set of cross members and anchoring of the diagonal cords. Control of the experiment will be from the orbiter mission specialist station. Normal operation is by automatic processing control software. Machine operating data are displayed and recorded on the ground. Data is processed and formatted to show progress of the major experiment parameters including stable operation, physical symmetry, joint integrity, and structural properties. A.R.H.

N79-21358*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE VOYAGER MAGNETOMETER BOOM
David C. Miller. *In* NASA. Ames Res. Center. The 12th Aerospace Mech. Symp. Apr. 1979 p 51-62 refs

(Contract NAS7-100)
Avail: NTIS HC A11/MF A01 CSCL 20K

The Voyager spacecraft magnetometer experiment utilizes two sensors on a deployable boom. The boom is an Astromast. The implementation of the Astromast into the Voyager design is described along with the hardware used to hold, latch, and deploy the mast and the tests to demonstrate damping, deployment, and alignments. Several problems encountered are discussed and their solutions are given. Flight deployment and preliminary alignment results are presented. Finally, the design is evaluated in retrospect. J.M.S.

N79-21372*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
DEPLOYABLE ANTENNA REFLECTOR
William B. Palmer. *In* NASA. Ames Res. Center. The 12th Aerospace Mech. Symp. Apr. 1979 p 223-232

Avail: NTIS HC A11/MF A01 CSCL 20K

The first phase in the development of a solid surface, deployable, antenna reflector is outlined and discussed. The deployment concept is described in conjunction with illustrations and photos of the fabricated reflector models. Details and results of the thermal distortion analysis are presented. Results indicate that the discussed reflector concept is an effective approach in satisfying the requirements for large deployable antennas in the 6 GHz to 100 GHz frequency regime. Author

04
CONTROL SYSTEMS

Includes new attitude and control techniques, improved surface accuracy measurement and control techniques.

A79-10509 * **Dynamics and control of large satellites.** R. J. Herzberg, K. F. Johansen, and R. C. Stroud (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) *Astronautics and Aeronautics*, vol. 16, Oct. 1978, p. 35-39.

The challenges of controlling large satellite structures will demand a greater degree of cooperation between controls and structures disciplines as well as refinements in these technologies. Procedures proven effective for loads determination may be inadequate for structural dynamic representation in advanced control applications. On the other hand, certain existing structural dynamic test methods are applicable to modal-control functions. This paper reviews various aspects of the dynamics and control of large satellites, giving attention to modal frequency spectrum effects on control system design and the need for flexible-body models in the observer concept for active modal control. B.J.

A79-11173 **Electrostatically controlled wire-mesh antenna.** J. H. Lang, J. R. Girsh, and D. H. Staelin (MIT, Cambridge, Mass.) *Electronics Letters*, vol. 14, Sept. 28, 1978, p. 655, 656. 6 refs. Research supported by the Fannie and John Hertz Foundation; Grant No. DAAG29-78-C-0020.

A satellite-antenna concept is described that permits large-diameter reflectors to be deployed from a single Space Shuttle payload by using the lightest available reflecting surface. Antenna diameters up to one kilometer are sought for a wire-mesh reflector stretched across a hoop and distended electrostatically into parabolic shape. (Author)

A79-11240 **Dynamics, control, and structural flexibility results from the Hermes mission.** F. R. Vigneron (Department of Communications, Communications Research Centre, Ottawa, Canada). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-101*. 16 p. 13 refs.

Hermes (also known as the Communications Technology Satellite) is a 3-axis stabilized experimental high power communications satellite operating in the 12/14 GHz band. The satellite is structurally nonrigid as a result of its large light-weight deployable solar array, and is instrumented with accelerometers and other special purpose sensors which enable observation of its structural dynamics properties. A formal program of prelaunch analysis, ground test, and in-orbit observations and tests has been conducted with a view to establishing the solar array and attitude control technology required for futu- high-power satellites of this type. The current paper reviews and summarizes results from this activity. (Author)

A79-11241 * **Modal control of the planar motion of a long flexible beam in orbit.** R. Sellappan and P. M. Bainum (Howard University, Washington, D.C.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-102*. 18 p. 7 refs. Grant No. NsG-1414.

Attitude control techniques for the pointing and stabilization of very large, inherently flexible spacecraft systems are investigated. The attitude dynamics and control of a long, homogeneous flexible beam whose center of mass is assumed to follow a circular orbit is analyzed. In this study, first order effects of gravity-gradient are included, whereas external perturbations and related orbital station keeping maneuvers are neglected. A mathematical model which describes the system deflections within the orbital plane has been developed by treating the beam as having a maximum of three discretized mass particles connected by massless, elastic structural elements. The uncontrolled dynamics of this system are simulated and, in addition, the effects of the control devices are considered. The concept of distributed modal control, which provides a means for controlling a system mode independently of all other modes, is examined. The effect of varying the number of modes in the model as well as the number and location of the control devices are also considered. (Author)

A79-12325 **Transient attitude dynamics of satellites with deploying flexible appendages.** K. W. Lips and V. J. Modi (British Columbia, University, Vancouver, Canada). *International Astronautical Federation, International Astronautical Congress, 28th, Prague, Czechoslovakia, Sept. 25-Oct. 1, 1977.) Acta Astronautica*, vol. 5, Oct. 1978, p. 797-815. 23 refs. National Research Council of Canada Grant No. A-2181.

A general formulation is presented for librational dynamics of satellites with an arbitrary number, types, and orientation of deploying flexible appendages. The generalized force term is incorporated, making the formulation applicable to a wide variety of situations where aerodynamic forces, solar radiation, earth's magnetic field, etc., become significant. In particular, the case of a beam-type flexible appendage deploying from a satellite in an arbitrary orbit is considered. The corresponding nonlinear nonautonomous equations for in-plane and out-of-plane vibrations are derived, allowing for the variation of mass density and flexural rigidity along the length with time-dependent deployment velocity and spin rate. Next, attention is focused on the linearized analysis of the in-plane vibrational equation using the assumed-mode method and its substantiation through numerical integration. Finally, results for both steady-state and transient attitude behavior for a representative gravity-gradient configuration for a range of initial conditions and system parameters are given which show the combined effect of flexibility and deployment on the dynamics of the system to be substantial. (Author)

A79-12405 * **Control of surface shape by application of concentrated loads.** D. Bushnell (Lockheed Research Laboratories, Palo Alto, Calif.). In: Symposium on Applications of Computer Methods in Engineering, Los Angeles, Calif., August 23-26, 1977, Proceedings. Volume 1. Los Angeles, University of Southern California, 1978, p. 47-75. 23 refs. Research sponsored by the Lockheed Independent Research Program.

The paper describes an analysis tool which can be used to determine the efficiency of arbitrary distributions of concentrated loads (actuators) in controlling the shape of an axisymmetric plate or shell structure. In particular, the BOSOR6 and ACTUATOR computer programs are applied to the analysis of large space telescope-type mirror structures. Theoretical examples are treated in which spherical and flat mirrors of sandwich and monocoque wall co- tion are initially distorted by prescribed nonuniform temp- manufacturing imperfections. These initial distortions are acted by force or moment actuators such that the mean-square residual surface figure error is minimized for each given number and distribution of actuators. B.J.

A79-12613 * **Stability of spacecraft during asymmetrical deployment of appendages.** R. Sellappan and P. M. Bainum (Howard University, Washington, D.C.). *Journal of Guidance and Control*, vol. 1, Nov.-Dec. 1978, p. 446-448.

The stability of a spinning spacecraft during deployment of rigid appendages along one of the transverse axes is investigated with the use of the Sonin-Polya theorem. The equations of motion are the second-order differential equations for the transverse components of the angular momentum. Stability results are obtained by application of the Sonin-Polya theorem. P.T.H.

A79-14218 **Structural dynamics and configuration control of spinning and gravity oriented multibody systems.** V. J. Modi and S. C. Sharma (British Columbia, University, Vancouver, Canada). In: Dynamics of multibody systems. Proceedings of the Symposium, Munich, West Germany, August 29-September 3, 1977. Berlin, Springer-Verlag, 1978, p. 245-259. 7 refs. National Research Council of Canada Grant No. A-2181.

A general formulation for a triaxial multibody system, in a circular orbit, with rigid or elastic interconnecting links in the form of tether or beam is developed. The highly complicated coupled, nonlinear, nonautonomous equations for rotational motion are linearized and their exact solution presented. Expressions for forces and moments required to position and orient an object in space are obtained. Analytical procedures are applied to several configurations of practical interest. General character of the analysis makes it a useful tool in analyzing a wide range of existing and future spacecraft. (Author)

A79-14266 **Self-steering arrays.** W. H. Kummer (Hughes Aircraft Co., Culver City, Calif.). In: International Telemetering Conference, Los Angeles, Calif., October 18-20, 1977, Proceedings. Pittsburgh, Pa., Instrument Society of America, 1977, p. 291-301.

Self-steering arrays using complete receiver-transmitter signal processing systems to direct the beam of an antenna automatically have been developed. These systems offer an alternative to mechanically gimballed systems for satellite communication applications. The operation of such systems using either a pilot signal or a phased lock loop technique for self-steering is described. Also described is an engineering model built for satellite-to-earth communications which incorporates these techniques. Additionally, other systems now in breadboard configurations are mentioned briefly. A summary of power requirements for a projected 25-module system has been included to indicate the feasibility of large systems. Test results for the engineering model have proved satisfactory, and show that these systems can definitely be valuable in applications similar to the tracking and data relay satellite system (TDRSS) described here. (Author)

A79-19591 **Dynamics and control of large flexible spacecraft with nonlinear trajectory.** J. N. Juang (Martin Marietta Aerospace, Denver, Colo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0194.* 6 p. 16 refs.

The governing equation of motion and its transformation is considered along with aspects of controllability and observability for the reducible system. It is found that a large majority of large flexible dynamic systems are nonlinear over a wide range of amplitudes of the dynamical quantities involved. Even though these systems contain nonnegligible nonlinearities in their normal range of performance, a linearized form of their state equation will be a valid approximation, provided that the state variables involved do not vary too widely from their nominal states about which linearization takes place. If the linear system is reducible in the sense of Liapunov, the time-variant characteristics matrix can be transformed to a time-invariant Jordan matrix. G.R.

A79-19592 * **Decentralized control of large space structures via forced singular perturbation.** J. R. Sesak and T. Coradetti (General Dynamics Corp., Convair Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0195.* 10 p. 19 refs.

A new, decentralized, optimal-control methodology is applied to control the elastic modes of a large space structure. The controller, based on forced singular perturbation model reduction, differs from the usual optimal controller in that each feedback gain does not affect every state of the plant model. The control law forces weak coupling in the closed-loop system although strong coupling might exist in the open-loop plant model. This allows a high-order plant to be controlled in decoupled subsections: sets of vibratory modes are controlled by local optimal controllers. Closed-loop decoupling eliminates the need for coordination and information exchange among the local controllers, reducing computational requirements and resulting in a simplified, distributed controller structure. The order of the plant model need not be reduced. Full order control is provided by the local optimal controllers. The method provides redundancy if two or more controllers stabilize modes of overlapping modal subsets. (Author)

A79-19593 * **Reduced order control of large structures in space.** M. J. Balas (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0196.* 9 p. 26 refs.

A large number of vibration modes must be used to model the dynamic behavior of large structures in space (LSS), because LSS are extremely mechanically flexible. However, on-board computer capacity and the available number and placement of control devices (sensors or actuators) limit the number of these modes that can be actively controlled. In this paper, active control of a set of critical modes is obtained by means of a low-order compensator. It is shown that the addition of each control device allows the reduction of the compensator size by one; thus, control devices versus computer capacity is the basic design trade-off. (Author)

A79-21507 * **Control of surface configuration of nonuniformly heated shells.** D. Bushnell (Lockheed Research Laboratories, Palo Alto, Calif.). *AIAA Journal*, vol. 17, Jan. 1979, p. 78-84. Research sponsored by the Lockheed Independent Research and Development Program.

The effectiveness of arbitrary distributions of concentrated loads (actuators) in controlling the surface quality of spherical caps and circular plates is determined by a numerical analysis. The residual root-mean-squared (rms) surface error of sandwich and monocoque shells is calculated as a function of the number, placement, and type of actuators. It is found that for a spherical cap with sandwich wall, diameter-to-thickness ratio of 400, and radius of curvature-to-thickness ratio of 2000, about 100 force actuators are required to reduce an initial rms surface error by two orders of magnitude. (Author)

A79-23504 * **Optimal estimation of large structure model errors.** G. Rodriguez (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0198.* 9 p. 7 refs. Contract No. NAS7-100.

In-flight estimation of large structure model errors is usually required as a means of detecting inevitable deficiencies in large structure controller/estimator models. The present paper deals with a least-squares formulation which seeks to minimize a quadratic functional of the model errors. The properties of these error estimates are analyzed. It is shown that an arbitrary model error can be decomposed as the sum of two components that are orthogonal in a suitably defined function space. Relations between true and estimated errors are defined. The estimates are found to be approximations that retain many of the significant dynamics of the true model errors. Current efforts are directed toward application of the analytical results to a reference large structure model. V.P.

A79-23795 **Hybrid computer simulation of two nonlinear attitude controllers for flexible spacecraft.** T. M. M. Abdel-Rahman (Spar Aerospace Products, Ltd., Toronto, Canada) and P. C. Hughes (Toronto, University, Downsview, Ontario, Canada). In: Modeling and simulation. Volume 9 - Proceedings of the Ninth Annual Pittsburgh Conference, Pittsburgh, Pa., April 27, 28, 1978. Part 3. Pittsburgh, Pa., Instrument Society of America, 1978, p. 1229-1236. 12 refs.

Two important and practical controllers, 'pseudorate' and 'integral-pulse-frequency', are investigated for the jet-thruster attitude control of flexible spacecraft. A hybrid computer simulation is employed to investigate their performance, and is automated to evaluate responses for several thousand sets of initial conditions. This process is repeated for many combinations of sensor and structural parameters, and leads to general recommendations on the use of these controllers for flexible spacecraft. (Author)

A79-23798 **The effect of flexible boom models on the modelling of the pitch control system of a dual-spin spacecraft.** G. M. Swisher (Tennessee Technological University, Cookeville, Tenn.). In: Modeling and simulation. Volume 9 - Proceedings of the Ninth Annual Pittsburgh Conference, Pittsburgh, Pa., April 27, 28, 1978. Part 4. Pittsburgh, Pa., Instrument Society of America, 1978, p. 1391-1397. 9 refs.

Digital simulation of the pitch loop control system of a spacecraft assumed to be a central rigid body with long tubular appendages (booms) was carried out for several different boom models. The models are: (1) a rigid-body model, (2) a first-order model, where each boom is modeled as a massless cantilever beam with an end mass, and (3) a second-order model which lumps each boom into two equal masses joined by massless springs. Two variants of the second-order model were tried: (2a) a model that assumes that each lump is one-half the total boom mass and the lengths are equal but adjusted so that the first natural frequency matches the distributed model, and (3b) which assumes that each half of the boom is a first-order model with an effective end mass and a massless spring of length L/2. Both 11-m and 22-m boom lengths were considered. Model 3a predicts less boom interaction and more rigid body motion characterization than the first-order model for long-length booms. It predicts smaller boom tip oscillations when a structural filter is used. With no structural filter, the first-order model and model 3a predict similar boom interactions. P.T.H.

N79-10092*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TECHNOLOGY FOR ACCURATE SURFACE AND ATTITUDE CONTROL OF A LARGE SPACEBORNE ANTENNA AND MICROWAVE SYSTEM
John B. Dahlgren. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 1, 1978, p. 441-456.

Avail: NTIS HC A23/MF A01 CSCL 22B

Problems associated with controlling a large diameter (200 - 300 m) spaceborne antenna and microwave system operating at frequencies in the range from 20 GHz to at least 300 GHz are addressed. Such large structures must point to any new target and settle in one hour, and have control surface accuracy to 50 microns rms. Critical technologies required to enable system development by 1990 to 2000 for radio/radar astronomy, orbiting Deep Space relay satellite, SETI, very long base interferometry, and earth looking radiometry applications are discussed. A.R.H.

N79-10093*# TRW Systems Group, Redondo Beach, Calif. Control and Sensor Systems Lab.
INFLIGHT OPTICAL MEASUREMENT OF ANTENNA SURFACES
R. S. Nelsewander. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 1, 1978, p. 457-489.

Avail: NTIS HC A23/MF A01 CSCL 22B

A technology base was developed for a wide variety of applications oriented sensors to meet requirements for the fabrication, assembly, test, surface figure monitoring, and ultimately surface figure active control of large space antennas. An optical sensor technique is described which establishes an ideal centerline at each beam during fabrication or later during assembly. Deviations from the centerline, either in lateral deformation or in twist, are measured to produce limit warnings or to evoke active control at the building machine. A.R.H.

N79-10094*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STRUCTURAL ALIGNMENT SENSOR
L. Davis, N. E. Buholz, C. W. Gilliard, C. C. Huang, and W. M. Wells, III. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 1, 1978, p. 491-501.

Avail: NTIS HC A23/MF A01 CSCL 22B

Comparative Michelson interferometers are discussed as well as the operating range potential of a structural alignment sensor (SAS) which requires only one laser mode. Schematics are presented for the distance measurement logic, the basic SAS system, the SAS optical layout, the coarse measurement signal processor, and the measured range resolution. A.R.H.

N79-10106*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LARGE STRUCTURE CONTROL DEVELOPMENT CONCEPTS
G. Rodriguez. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 2, 1978, p. 903-934.

Avail: NTIS HC A22/MF A01 CSCL 22B

Viewpoints are presented on large structure control evolving from the solar sail study conducted at JPL. The objective is to make optimum use of insights gained in the study in order to assess required large structure control developments. L.S.

N79-10109*# Rockwell International Corp., El Segundo, Calif.
CONTROL CONCEPTS FOR LARGE SPACE STRUCTURES
R. C. Quartararo. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 2, 1978, p. 935-957.

Avail: NTIS HC A22/MF A01 CSCL 22B

A comprehensive program to develop the required control technology was started at Rockwell International's Space Division. A few of the concepts under consideration for attitude figure and vibration control of large flexible space systems are highlighted. In addition, an overview of the Space Division's independent research and development (IR&D) is presented. The direction of the IR&D program was influenced by requirements for electro-optical systems, shuttle erectable structures, and satellite power stations. L.S.

N79-10110*# General Dynamics/Convair, San Diego, Calif.
LARGE SPACE PLATFORM CONTROL AVIONICS CONSIDERATIONS
Jack G. Fisher. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 2, 1978, p. 959-987. refs

(Contracts NAS9-15310; F04701-77-C-0178)
Avail: NTIS HC A22/MF A01 CSCL 22B

A number of areas requiring technology efforts are identified. Some of these areas associated with the avionics oriented technologies required for design and operation of many of these large spacecraft are discussed. L.S.

N79-10111*# Boeing Aerospace Co., Seattle, Wash.
MANEUVERING AND POINTING FLEXIBLE VEHICLES
Douglas C. Fouth. *In* NASA. Langley Res. Center: Large Space Systems Technol., Vol. 2, 1978, p. 989-1020.

Avail: NTIS HC A22/MF A01 CSCL 22B

With the development of techniques to assemble large structures in orbit, new control system problems evolve. These large structures are typically characterized by lower structural frequencies, but no compromises are made regarding maneuver and structural settling times. Techniques are discussed which will allow these large structures to be maneuvered and pointed quickly with minimum settling times. L.S.

N79-15120*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

OAST SPACE THEME WORKSHOP. VOLUME 3: WORKING GROUP SUMMARY. 1: NAVIGATION, GUIDANCE, CONTROL (E-1) A. STATEMENT. B. TECHNOLOGY NEEDS (FORM 1). C. PRIORITY ASSESSMENT (FORM 2)

1978 60 p Workshop held at Langley Station, Va., 28-30 Apr 1976 17 Vol

(NASA-TM-80008) Avail: NTIS HC A04/MF A01 CSCL 22A

The six themes identified by the Workshop have many common navigation guidance and control needs. All the earth orbit themes have a strong requirement for attitude, figure and stabilization control of large space structures, a requirement not currently being supported. All but the space transportation theme have need for precision pointing of spacecraft and instruments. In addition all the themes have requirements for increasing autonomous operations for such activities as spacecraft and experiment operations, onboard mission modification, rendezvous and docking, spacecraft assembly and maintenance, navigation and guidance, and self-checkout, test and repair. Major new efforts are required to conceptualize new approaches to large space antennas and arrays that are lightweight, readily deployable, and capable of precise attitude and figure control. Conventional approaches offer little hope of meeting these requirements. Functions that can benefit from increasing automation or autonomous operations are listed. A.R.H.

05
ELECTRONICS

Includes techniques for power and data distribution

A79-19619 * On the use of fiber optics on board satellites. G. Perrotta (Selenia, S.p.A., Rome, Italy). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0247.* 9 p. 9 refs.

The perspective use of optical fibers on board satellites is briefly examined from the conceptual viewpoint. Forthcoming satellites will be characterized by multifunctions multitransponders communication payloads. Mass, mechanical layout and ever increasing EMI problems will thus constitute potential technical limitations on board these satellites. Starting from the low mass and EMI immunity properties of optical fibers, two possible applications are considered: a) for signals routing instead of copper wires to reduce mass and EMI, b) in a regenerative repeater information demodulation and processing at baseband frequencies can be combined with optical fibers to decouple and optimally locate the repeater sections within the spacecraft. (Author)

N79-10127*# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio
MILITARY NEEDS FOR ORBITAL POWER
L. D. Massie, R. R. Bartholemy, and E. T. Mahaffey. *In* NASA Lewis Res. Center Future Orbital Power Systems Technol. Requirements. Sep. 1978 p 93-107 refs

Avail: NTIS HC A09/MF A01 CSCL 10A

Results of the DoD/ERDA (now Department of Energy) Space Power Study completed in October 1977 are presented. The major new thrust of Air Force Advanced Technology Plans center on the development of military solar power systems which will extend capabilities to the 10 - 50 KW sub e power range for new classes of missions while maintaining technology applicability to the 0.5 - 10 KW sub e present mission class. The status of FY78 efforts for Project 682J (Air Force Space Power Advanced Development Program) are reported. Project 682J is divided into the following tasks: (1) high efficiency solar panel, (2) nickel-hydrogen battery, (3) gallium arsenide solar concentrator hardness study, and (4) new start nuclear dynamic power system application/integration study. G.Y.

N79-10134*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
POWER MANAGEMENT AND CONTROL FOR SPACE SYSTEMS
Robert C. Finke, Ira T. Myers, Fred F. Terdan, and N. John Stevens. *In its* Future Orbital Power Systems Technol. Requirements. Sep. 1978 p 195-207

Avail: NTIS HC A09/MF A01 CSCL 10A

Power management and control technology for the large, high power spacecraft of the 1980's is discussed. Systems weight optimization that indicate a need for higher bus voltages are shown. Environmental interactions that are practical limits for the maximum potential on exposed surfaces are shown. A dual voltage system is proposed that would provide the weight savings of a high voltage distribution system and take into account the potential environmental interactions. The technology development of new components and circuits is also discussed. G.Y.

N79-10135*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va.
DAST SPACE THEME WORKSHOP. VOLUME 3: WORKING GROUP SUMMARY. B: POWER (P-2). A. STATEMENT. B. TECHNOLOGY NEEDS (FORM 1). C. PRIORITY ASSESSMENT (FORM 2)
1978 123 p Workshop held at Langley Station, Va., 28-30 Apr. 1978. 17 Vol.
(NASA-TM-80013) Avail: NTIS HC A06/MF A01 CSCL 22A

Power requirements for the multipurpose space power platform, for space industrialization, SETI, the solar system exploration facility, and for global services are assessed for various launch dates. Priorities and initiatives for the development of elements of space power systems are described for systems using light power input (solar energy source) or thermal power input (solar, chemical, nuclear radioisotopes, reactors). Systems for power conversion, power processing, distribution and control are likewise examined. A.R.H.

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06
ADVANCED MATERIALS

Includes matrix composites, polyimide films and thermal control coatings, and space environmental effects on these materials.

A79-10476 **Manufacturing and behavior of materials in space (Poluchenie i povedenie materialov v kosmose).** Edited by A. S. Okhotin. Moscow, Izdatel'stvo Nauka, 1978. 248 p. In Russian.

The work presents papers on materials processing in space, with attention given to such problems as crystal growth from melts under conditions of weightlessness, the growth of semiconductor crystals from the vapor phase, the effect of heat treatment on the mechanical properties of high-strength titanium alloys, the effect of temperature on the hardness and fracture properties of silicon carbide single crystals, and an injector for the simulation of cosmic dust fluxes. Special consideration is also given to space radiation effects on different types of materials; papers are presented on the alpha particle-irradiation of silicon solar cells, the zonal sensitivity of thermoelectric IR-detectors, changes in the strength of polymers after irradiation in the loaded state, and the effects of radiation on the thermoelectric and thermophysical properties of certain semiconductors. B.J.

A79-10481 **Investigation of structure and element distribution in electron-beam-welded joints of the 1201 and AMg6 alloys under conditions of weightlessness (Issledovanie struktury i raspredelenia elementov v svarnykh soedineniiakh, vypolnennykh elektronnym luchom na splavakh 1201 i AMg6 v usloviiakh nevesomosti).** A. A. Bondarev, V. F. Lapchinskii, A. V. Lozovskaia, and E. G. Ternovoi. In: Manufacturing and behavior of materials in space. Moscow, Izdatel'stvo Nauka, 1978, p. 21-29. 5 refs. In Russian.

A79-10590 * **Thermal vacuum facility with in-situ mechanical loading.** R. C. Tennyson, J. S. Hansen, R. P. Holzer, B. Uffen, and G. Mabson (Toronto, University, Toronto, Canada). In: Space Simulation Conference, 10th, Bethesda, Md., October 16-18, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 97-103. National Research Council of Canada Grant No. A-2783; Grant No. NsG-7409. (AIAA 78-1620)

The paper describes a thermal-vacuum space simulator used to assess property changes of fiber-reinforced polymer composite systems. The facility can achieve a vacuum of approximately .0000001 torr with temperatures ranging from -200 to +300 F. Some preliminary experimental results are presented for materials subjected to thermal loading up to 200 F. The tests conducted include the evaluation of matrix modulus and strength, coefficients of thermal expansion, and fracture toughness. Though the experimental program is at an early stage, the data appear to indicate that these parameters are influenced by hard vacuum. B.J.

A79-15496 **Advanced composites technology; Proceedings of the Conference, El Segundo, Calif., March 14-16, 1978.** Conference sponsored by the Technology Conferences Associates. El Segundo, Calif., Technology Conferences Associates, 1978. 284 p. $25.

Papers are presented on the design of high-performance boron nitride fibers, metallo-plastic materials, basalt fibers, and glass and carbon fiber thermoplastic composite materials. Consideration is given to the application of pitch-based carbon fibers as reinforcements, an elastomeric tooling design for advanced composites, adhesive-bonded joints for composites, and aerospace applications of graphite-reinforced thermoplastic composites. Industrial and commercial uses of advanced fiber composites are identified and a study of environmental effects on aerospace-grade composites is presented. S.C.S.

A79-15504 * **Advanced composites - Future space applications.** R. A. Boundy (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Advanced composites technology; Proceedings of the Conference, El Segundo, Calif., March 14-16, 1978. El Segundo, Calif., Technology Conferences Associates, 1978, p. 197-215. 20 refs. Contract No. NAS7-100.

Potential applications of composite materials in kilometer-size space systems are reviewed, noting the advent of the NASA Space Transportation System. Antenna configurations are considered with reference to the 10-m-diam wrapped-rib antenna used on the ATS-6 satellite, a 15-m-diam graphite-epoxy wrapped-rib antenna, and a folding planar array synthetic aperture radar antenna. The heliogyro solar sail concept is presented along with solar power station designs based on either photovoltaic arrays or parabolic arrays of flat facets. The development of beam fabricators is described. S.C.S.

A79-15505 **Aerospace application of graphite reinforced thermoplastic composites.** J. T. Hoggatt (Boeing Aerospace Co., Seattle, Wash.). In: Advanced composites technology; Proceedings of the Conference, El Segundo, Calif., March 14-16, 1978. El Segundo, Calif., Technology Conferences Associates, 1978, p. 216-222.

The article describes applications of the structural and/or manufacturing capabilities of graphite-reinforced thermoplastic composites in the aerospace industry. Five major areas are considered: (1) aircraft applications such as the YC-14 elevator, the F-16 strake, landing gear doors, F-16 access doors, and 737 spoilers, (2) helicopter applications including radomes, body fairings, floor panels, and access doors, (3) missile applications noting the BOM34E body section and ICBM interstage subelements, (4) marine systems applications such as the control flap section for the PCH-1, and (5) space systems applications including trusses, antenna reflectors, and tubing. S.C.S.

A79-15508 **A study of environmental effects on aerospace grade composites.** J. H. Kreiner (California State Polytechnic University, Pomona, California State University, Fullerton, Calif.) and M. Almon (Delsen Testing Laboratories, Glendale, Calif.). In: Advanced composites technology; Proceedings of the Conference, El Segundo, Calif., March 14-16, 1978. El Segundo, Calif., Technology Conferences Associates, 1978, p. 272-279. 6 refs.

The influence of variations in relative humidity on the stiffness characteristics of a graphite-epoxy composite subjected to cyclic bending at a constant temperature and load has been evaluated. The testing system consisted of a loading device, an environmental chamber, and a recording system. The results show a more pronounced effect with the first few thousand cycles and a gradual decrease. Tests conducted at various specific humidity levels show that saturation influence is achieved and that the deflection remains constant from about 4,000 to 10,000 cycles. S.C.S.

A79-16982 * **A perspective on composites.** A. M. Lovelace (NASA, Washington, D.C.). In: ICCM-2; Proceedings of the Second International Conference on Composite Materials, Toronto, Canada, April 16-20, 1978. Warrendale, Pa., Metallurgical Society of AIME, 1978, p. 3-8.

The development of composites in the United States in the 1960s and 1970s is briefly reviewed with emphasis on aerospace applications. Consideration is given to such highlights as the manufacture of boron filaments, the use of boron-epoxy composites for aerospace structures, graphite-epoxy composites, and current graphite R & D work. B.J.

A79-17021 **Mechanical and thermal behavior characterization of composite materials for communications spacecraft.** C. K. H. Dharan (Ford Aerospace and Communication Corp., Palo Alto, Calif.). In: ICCM/2; Proceedings of the Second International Conference on Composite Materials, Toronto, Canada, April 16-20, 1978. Warrendale, Pa., Metallurgical Society of AIME, 1978, p. 735-749. 12 refs.

An elastoplastic stress analysis was conducted to determine the stress-strain state of copper plating on various graphite-epoxy substrate materials during thermal cycling. Attention is given to the effect of long-term thermal cycling on metallized composites and to the stability of the coefficient of thermal expansion (CTE). The results indicate that the plating undergoes elastoplastic cyclic loading in both the tension and compression regimes. A low-cycle fatigue theory and recent fatigue data on copper were used to determine the number of cycles for low-cycle fatigue failure of the plating. A lower value for the number of cycles to failure was established when a similar analysis was performed to determine the stress state of the woven graphite-epoxy substrate. The probable failure mechanism appears to be one in which microcracks generated by thermal fatigue propagate into and cause failure of the plating. The weave is predicted to have a crack-arresting quality. During initial thermal cycling, significant changes in the CTE can occur. S.D.

A79-20810 * **Fabrication of composite shell structure for advanced space transportation.** A. P. Penton, R. Johnson, Jr., and V. L. Freeman (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Selective application of materials for products and energy; Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 2-4, 1978.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 137-149. Contract No. NAS1-14547.

It is pointed out that future space missions, such as those involving spacecraft and structural assemblies to be used in geosynchronous orbits, will require ultralightweight composite structures to achieve maximum payloads. Of equal importance is the requirement to provide designs that are cost-competitive with metal designs. For space structures that must resist buckling, graphite-epoxy materials offer an attractive potential for providing lightweight, low-cost structural components that will meet future space mission requirements. A description is presented of a program which was conducted to evaluate the merits of graphite-epoxy cylindrical shells and to continue the development of a design data base for ultralightweight structures. An objective of the program was to design, fabricate, and test a corrugated graphite-epoxy cylinder 10 ft in diameter and 10 ft long. G.R.

A79-24112 **Stability analysis and testing of thin-walled open-sectioned graphite/thermoplastic structures.** E. E. Spier (General Dynamics Corp., Convair Div., San Diego, Calif.). In: Materials synergisms; Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 452-465. 6 refs.

Two candidate cross sections and several graphite/thermoplastic laminates are considered for a compression member of specified length. The stability of the structures under compression loads is analyzed by means of a linear-nonlinear finite-difference computer code called structural analysis of general shells (STAGSC). The results of two crippling tests are compared with a corresponding postbuckling analysis. M.L.

N79-10106*# Boeing Aerospace Co., Seattle, Wash.
APPLICABILITY OF THERMOPLASTIC COMPOSITES FOR SPACE STRUCTURES
J. T. Hoggatt and M. Kushner. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 2, 1978, p. 775-832.

Avail: NTIS HC A22/MF A01 CSCL 22B

The discussion defines a thermoplastic resin and compares the structural and environmental properties and the fabrication and repairability of the thermoplastic composite with a typical epoxy composite. Low labor costs exhibited by the thermoplastic composites make them a priority consideration for use in space structure. L.S.

N79-10106*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
SPACECRAFT CHARGING AND PLASMA INTERACTION IMPLICATIONS FOR LARGE SPACE SYSTEMS
E. Miller, M. Stauber, M. Rossi, and W. Fischbein. *In its* Large Space Systems Technol., Vol. 2, 1978, p. 833-865.

Avail: NTIS HC A22/MF A01 CSCL 22B

Specific discharge mechanisms, plasma interactions, and scale effects associated with very large spacecraft are studied. The large area, low density character, and extensive use of nonconducting materials is thought to have a major impact on the performance and survivability of many large space systems. L.S.

N79-10107*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
MATERIALS TECHNOLOGY DEVELOPMENT FOR LONG LIFE LARGE SPACE SYSTEMS
Raymond L. Gause. *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 2, 1978, p. 867-901.

Avail: NTIS HC A22/MF A01 CSCL 22B

Large Space Systems materials requirements are discussed in terms of types of materials, critical properties, and environmental stability. An outline is given of the materials technology development that will be needed to meet these requirements. L.S.

N79-15128*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 3: WORKING GROUP SUMMARY. 7: MATERIAL (M-1). A. STATEMENT. B. TECHNOLOGY NEEDS (FORM 1). C. PRIORITY ASSESSMENT (FORM 2)
1978, 127 p. Workshop held at Langley Station, Va., 26-30 Apr. 1976, 17 Vol.
(NASA-TM-80014) Avail: NTIS HC A07/MF A01 CSCL 22A

The approach of matching technology areas with various themes needs was not effective for the materials and thermal control discipline because of the diversity of requirements for each. Top priorities were evolved from the advanced space transportation system and the space power platform because these are essential building blocks in fulfilling some of the other themes. Important needs identified include life long-life cryogenic cooling systems for sensors, masers, and other devices and the needs for lightweight nuclear shielding materials for nuclear electric propulsion. A.R.H.

07
ASSEMBLY CONCEPTS

Includes automated manipulator techniques, EVA, robot assembly, teleoperators, and equipment installation.

A79-10578 * # **Orbital construction support equipment - Manned remote work station.** S. H. Nassiff (NASA, Johnson Space Center, Houston, Tex.). In: Space Simulation Conference, 10th, Bethesda, Md., October 16-18, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 10-18. (AIAA 78-1603)

The Manned Remote Work Station (MRWS) is a versatile piece of orbital construction support equipment which can support in-space construction in various modes of operation. Proposed near-term Space Shuttle mission support and future large orbiting systems support, along with the various construction modes of MRWS operation, are discussed. Preliminary flight subsystems requirements and configuration design are presented. Integration of the MRWS development test article with the JSC Mockup and Integration Facility, including ground-test objectives and techniques for zero-g simulations, is also presented. (Author)

A79-11286 * **Shuttle demonstration of large space structure fabrication and assembly.** R. Fleisig (Grumman Aerospace Corp., Bethpage, N.Y.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-188.* 15 p. Contract No. NAS8-32390.

This paper describes a program aimed at the early on-orbit demonstration of a large space structure fabrication and assembly capability. Requirements for the demonstration concept have been formulated. The concept selected to meet these requirements is a Large Space Structure Platform consisting of a triangular prism of 31.5 m length. Sensors can be mounted on this platform to perform earth observation measurements from space. Structural elements of the platform are fabricated using an automated beam builder in the Shuttle Orbiter payload bay. Special fixtures are designed to assemble the structure with the aid of the remote manipulator system and two astroworkers in an EVA mode. Results of the platform preliminary design are presented in terms of a design layout with related structural, thermal, mass properties, and control dynamics data. The assembly scenario is described. Estimates of the total construction time and Orbiter support requirements are also presented. (Author)

A79-14416 **Manned extra vehicular activity operations during early space station missions.** G. L. Murphy, W. A. Cohen, and A. T. Pessa (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: SAFE Association, Annual Symposium, 15th, Las Vegas, Nev., December 5-8, 1977, Proceedings. Canoga Park, Calif., SAFE Association, 1977, p. 84-87.

A description is presented of the currently planned Shuttle Extravehicular Activity (EVA) system. This system consists of the Extravehicular Mobility Unit (EMU), Manned Maneuvering Unit (MMU), Shuttle airlock, and miscellaneous support equipment. The EMU, weighing approximately 83 kg, consists of a pressure garment and a life support system. A MMU provides extended range and flexibility during EVA. The MMU provides an EVA crewman with capability to reach areas without the use of handholds or other fixed mobility aids. Noncontaminating nitrogen is used for propulsion and the nominal operating range is 100 meters. Attention is given to typical space construction EVA tasks, EVA groundrules, and potential problem areas. G.R.

A79-15000 **Assembly research and manipulation.** J. L. Nevins and D. F. Whitney (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 16th, and Special Symposium on Fuzzy Set Theory and Applications, New Orleans, La., December 7-9, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 735-742. 13 refs. NSF Grants No. ATA 74-18173-A01; No. GI-43787; No. GI-39432x; No. GK-34094.

The current research issues in assembly being explored worldwide are discussed. The work falls under two main headings, namely, (1) parts mating science (the study of the phenomena which occur when parts interact during the assembly process) and (2) programmable assembly system (the study of economic machines which can be applied to batch manufacturing under conditions of model mix, design change, or rapid evolution or obsolescence of the product). Exploration of the parts mating question requires investigation into geometric, force-friction, and logical test characteristics of the mating process involving the generation of and the carrying out of very precise experiments to examine hypotheses. Programmability issues include the analysis of manufactured products to determine kinds of tasks, statistics of their occurrence, and geometric requirements on the placing and alignment of parts. (Author)

A79-18160 **Ultrasonic bonding - Panacea or pie in the sky.** J. Devine (Sonobond Corp., West Chester, Pa.), G. K. Dingle (Hughes Helicopters, Culver City, Calif.), and R. G. Vollmer (U.S. Army, Aviation Research and Development Command, St. Louis, Mo.). In: American Helicopter Society, Annual National Forum, 34th, Washington, D.C., May 15-17, 1978, Proceedings. Washington, D.C., American Helicopter Society, 1978. 6 p. (AHS 78-34)

The potential of ultrasonic bonding in the aerospace industry is briefly discussed in terms of a cost comparison with riveting, energy savings, and areas for which it is particularly suitable. It has been determined that an ultrasonically bonded joint costs approximately 1/10 of a cent per joint, whereas a certain riveting system ideally costs 1.4 cents per joint at 18 joints per minute. Where aluminum sheet or foil materials are used on a number of resistance spot welders, significant reduction in electrical energy requirements can be expected if ultrasonic welding techniques are adopted. Ultrasonic bonds are made with nugget quality at low temperature without Joule heating. Conventional ultrasonic bonding techniques are ideal with fiber reinforced metallic composites since the solid state joint does not cause breakage of the reinforcing fibers. P.T.H.

A79-25855 **Manual alignment of structural components in space.** C. S. Major (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D.C., Feb. 6-8, 1979, Paper 79-0535.* 8 p. 8 refs.

An astronaut is assumed to spread his arms in order to reach for the ends of the structure members to be joined. The present experimental study pursues two objectives: (1) to determine in what manner a person will rotate an object with a large moment of inertia, and whether practice significantly improves the person's control, and (2) to relate the necessary joint strength between two long members to the manner in which a person assembles the joint. It is shown that subjects readily perceive errors of angular position but fail to recognize significant angular velocities. Therefore, strong joints requiring close alignment can be easily assembled, whereas weaker joints may fail when the connection is made in the presence of a high angular velocity of the members. Subject performance shows little improvement with practice. S.D.

N79-10098*# Rockwell International Corp., Downey, Calif. Space Div.
EQUIPMENT INSTALLATION ON LARGE AREA SPACE SYSTEMS

E. Katz *In* NASA. Langley Res. Center Large Space Systems Technol., Vol. 2 1978 p 569-596

Avail: NTIS HC A22/MF A01 CSCL 22B

The requirements and concepts for the installation of various types of mission and subsystem equipment on large area space systems are discussed. L.S.

N79-11108* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPARATUS FOR ASSEMBLING SPACE STRUCTURE Patent
James D. Johnston, Richard H. Tuggle, Jr., John L. Burch, and Keith H. Clark, inventors (to NASA) Issued 31 Oct. 1978 13 p. Filed 31 Aug. 1977 Supersedes N77-31213 (15 - 22 p. 2904)
(NASA-Case-MFS-23579-1; US-Patent-4,122,991; US-Patent-Appl-SN-829316; US-Patent-Class-228-13; US-Patent-Class-228-15.1; US-Patent-Class-228-173; US-Patent-Class-244-159) Avail: US Patent Office CSCL 22B

An apparatus for producing a structure in outer space from rolls of prepunched ribbon or sheet material that are transported from the earth to the apparatus located in outer space is described. The apparatus spins the space structure similar to a spider spinning a web utilizing the prepunched ribbon material. The prepunched ribbon material is fed through the apparatus and is shaped into a predetermined channel shaped configuration. Trusses are pulled out of the ribbon and are bent downwardly and attached to a track which normally is a previously laid sheet of material. The size of the overall space structure may be increased by merely attaching an additional roll of sheet material to the apparatus. Official Gazette of the U.S. Patent Office

N79-16056*# Grumman Aerospace Corp., Bethpage, N.Y.
MANNED REMOTE WORK STATION DEVELOPMENT ARTICLE. Interim Review No. 1
27 Jun. 1978 252 p.
(Contract NAS9-15507)
(NASA-CR-151870; NSS-MR-RP-006) Avail: NTIS HC A12/MF A01 CSCL 22B

The two prime objectives of the Manned Remote Work Station (MRWS) Development Article Study are to first, evaluate the MRWS flight article roles and associated design concepts for fundamental requirements and embody key technology developments into a simulation program, and to provide detail manufacturing drawings and schedules for a simulator development test article. An approach is outlined which establishes flight article requirements based on past studies of Solar Power Satellite, orbital construction support equipments, construction bases and near term shuttle operations. Simulation objectives are established for those technology issues that can best be addressed on a simulator. Concepts for full-scale and sub-scale simulators are then studied to establish an overall approach to studying MRWS requirements. Emphasis then shifts to design and specification of a full-scale development test article. G.Y.

N79-16057*# Grumman Aerospace Corp., Bethpage, N.Y.
MANNED REMOTE WORK STATION DEVELOPMENT ARTICLE. Interim Review No. 2
8 Nov. 1978 260 p.
(Grant NAS9-15507)
(NASA-CR-151871; NSS-MR-RP-011) Avail: NTIS HC A12/MF A01 CSCL 22B

Flight article and associated design concepts are evaluated to meet fundamental requirements of a universal crew cabin to be used as a construction cherrypicker, a space crane turret, a roiled work station, or a free flyer. Key technology developments are embodied into a simulation program. A schedule and simulation test plan matrix is given for the open cabin cherry picker. A.R.H.

N79-19085*# Martin Marietta Corp., Denver, Colo.
INTEGRATED ORBITAL SERVICING STUDY FOLLOW-ON. VOLUME 1: EXECUTIVE SUMMARY Final Report
W. L. DeRocher, Jr. Jun. 1978 55 p. 3 Vol.
(Contract NAS8-30820)
(NASA-CR-150890; MCR-77-246-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 22A

Orbital maintenance concepts were investigated and the equipment for one-g demonstrations of axial and radial module exchange was designed in three control modes: manual direct control, supervisory control, and manually augmented control. Significant results obtained and the conclusions drawn are presented and discussed. The overall conclusion is that on-orbit servicing should be established as an ongoing space transportation system capability. J.M.S.

N79-19087*# Martin Marietta Corp., Denver, Colo.
INTEGRATED ORBITAL SERVICING STUDY FOLLOW-ON. VOLUME 3: ENGINEERING TEST UNIT AND CONTROLS Final Report
Jun. 1978 98 p. refs. 3 Vol.
(Contract NAS8-30820)
(NASA-CR-150892; MCR-77-246-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 22A

A one-g servicing demonstration system which can be used to investigate and develop, in a real time hands-on situation, a wide variety of the mechanism and control system aspects of orbital servicing in the form of module exchange is described including the engineering test unit and the servicer servo drive console. A series of recommendations for future work is given concerning the control problem and more efficient module exchanges, mechanical elements, and electronics. J.M.S.

08
PROPULSION

Includes propulsion designs utilizing solar sailing, solar electric ion and low thrust chemical concepts.

A79-16143 * Space power for space. J. P. Mullin (NASA, Space Power Systems Branch, Washington, D.C.). In: Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p. 6-1 to 6-18.

The total energy demanded by space missions of the future is expected to exceed past needs by orders of magnitude. The unit costs of this energy must be reduced from present levels if these missions are to be carried out at projected budget levels. The broad employment of electric propulsion and the capability to utilize novel high power sensors hinge on the availability of systems lighter by factors of ten or more than have flown to date. The NASA program aimed at providing the technological basis to meet these demands is described in this paper. Research and technology efforts in areas of energy conversion, storage and management are covered. In addition, work aimed at evolving the understanding necessary to cope with space environment interactions and at advanced concepts is described. (Author)

A79-16601 * Radiation energy conversion in space; Conference, 3rd, NASA Ames Research Center, Moffett Field, Calif., January 26-28, 1978, Technical Papers. Conference sponsored by NASA. Edited by K. W. Billman (NASA, Ames Research Center, Moffett Field, Calif.). New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics, Volume 61), 1978. 687 p. Members, $24., nonmembers, $45.

Concepts for space-based conversion of space radiation energy into useful energy for man's needs are developed and supported by studies of costs, material and size requirements, efficiency, and available technology. Besides the more studied solar power satellite system using microwave transmission, a number of alternative space energy concepts are considered. Topics covered include orbiting mirrors for terrestrial energy supply, energy conversion at a lunar polar site, ultralightweight structures for space power, radiatively sustained cesium plasmas for solar electric conversion, solar pumped CW CO2 laser, superelastic laser energy conversion, laser-enhanced dynamics in molecular rate processes, and electron beams in space for energy storage. P.T.H.

A79-18137 Helicopters for interplanetary space flight. R. H. MacNeal (MacNeal-Schwendler Corp., Los Angeles, Calif.) and J. M. Hedgepeth (Astro Research Corp., Santa Barbara, Calif.). In: American Helicopter Society, Annual National Forum, 34th, Washington, D.C., May 15-17, 1978, Proceedings. Washington, D.C., American Helicopter Society, 1978. 12 p. 22 refs. (AHS 78-11)

The Heliogyro is a solar sail that resembles a conventional helicopter in appearance and function. It has been proposed as the propulsion system for the Halley Comet rendezvous mission. The device is based on an analogy between the solar radiation forces acting on a reflector and the forces on an airfoil in a fluid stream. The vehicle spirals outward from the sun or inward into the sun, depending on the 'angle of attack' of the reflectors, which span out from a central hub as in a helicopter. The paper describes the hub and blade retention system, blade deployment, Halley rendezvous mission parameters, design of panels and battens, and dynamic analysis of the rotor. P.T.H.

A79-18725 Tomorrow's space propulsion. D. Bauer. *Flight International*, vol. 114, Dec. 30, 1978, p. 2319-2322.

The paper discusses near future interplanetary flight propulsion systems which must necessarily be more efficient than today's chemical rockets, though the latter have the great advantage of being cheaper to operate. Alternatives to the conventional chemical propulsion systems are presented, particularly nuclear and electric rocket motors, with some of their technical characteristics. One of the more significant advantages of the nuclear motor is its effectiveness for specific impulses between 750 sec and 1200 sec, whereas a chemical engine is good for specific impulses of up to only 430 sec. The electric motor has the advantage of needing no exhaust nozzle and, more importantly, of having a long running time. The magnitude of the electric motor's thrust, however, is very small. NASA's work on nuclear and electric propulsion systems is discussed in some detail, noting the NERVA and SERT projects. A nuclear motor has been developed by NASA which would increase planetary payload weight by 80 percent. NASA has also developed an 8 cm electric motor with a specific impulse of 3000 sec. Finally, mention is made of the usage of electric motors by ESA in the Ariane project for 1980. A.A.

N79-10139*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ECONOMICAL APPROACH TO SPACE POWER SYSTEMS.
Fred Teren. *In its* Future Orbital Power Systems Technol. Requirements, Sep. 1978, p. 265-270.

Avail: NTIS HC A09/MF A01, CSCL 10A.

Projected energy demand for all NASA, DoD and civil missions for the time span 1981 to 1995 are illustrated. Typical energy cost range from about $300 to $2000 per kW hr, with an average of about $800 per kW hr for long duration missions. At these levels, the cost of the required energy would be several billion dollars per year by about 1985 and might constrain the number and types of NASA programs to be carried out. NASA is extensively pursuing approaches for reducing nonrecurring costs. Two programs are presented for the development of an economical approach to space power systems. They are: (1) Economical Orbital Power (ECOP) with the objective to demonstrate the applicability of a commercial approach to the development of a low cost photovoltaic space power system; and (2) Space Power Experiment (SPEX) which has the objective to demonstrate the application of industrial hardware for space power systems. G.Y.

N79-12138*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
ASSESSMENT OF SEPS SOLAR ARRAY TECHNOLOGY FOR ORBITAL SERVICE MODULE APPLICATION. Final Topical Report.
30 Oct. 1978, 153 p. refs.
(Contract NAS9-15595)
(NASA-CR-151859, LMSC-D665410) Avail: NTIS HC A08/MF A01, CSCL 22B.

Work performed in the following assessment areas on the SEPS solar array is reported: (1) requirements definition; (2) electrical design evaluation; (3) mechanical design evaluation; and (4) design modification analysis. General overall assessment conclusions are summarized. There are no known serious design limitations involved in the implementation of the recommended design modifications. A section of orbiter and array engineering drawings is included. S.B.S.

N79-15124*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 3: WORKING GROUP SUMMARY. 5: PROPULSION (P-1). A. SUMMARY STATEMENT. B. TECHNOLOGY NEEDS (FORM 1). C. PRIORITY ASSESSMENTS (FORM 2).
1976, 118 p. Workshop held at Langley Station, Va., 26-30 Apr. 1976, 17 Vol.

(NASA-TM-80012) Avail: NTIS HC A06/MF A01 CSCL 22A

All themes require some form of advanced propulsion capabilities to achieve their stated objectives. Requirements cover a broad spectrum ranging from a new generation of heavy lift launch vehicles to low thrust, long life system for on-orbit operations. The commonality extent between propulsive technologies was established and group technologies were grouped into vehicle classes by functional capability. The five classes of launch vehicles identified by the space transportation theme were augmented with a sixth class, encompassing planetary and on-orbit operations. Propulsion technologies in each class were then ranked, and assigned priority numbers. Prioritized technologies were matched to theme requirements. A.R.H.

09
FLIGHT EXPERMENTS

Includes controlled experiments requiring high vacuum and zero G environment

A79-23576 * **On orbit testing for large space structures.** R. Gran and M. Rossi (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979. Paper 79-0406.* 5 p.

The problem with large space structures is that the structural dynamics cannot be tested on the ground. The structure must be designed and assembled in orbit before testing can begin. In the present paper, some aspects of on-orbit dynamic testing are examined in terms of a phase-locked loop adaptive spectrum analyzer that could provide mode frequencies and mode shapes for control design during orbital operations. Simulation results are discussed.

V.P.

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10
GENERAL

Includes either state of the art or advanced technology which may apply to Large Space Systems and does not fit within the previous nine categories. Shuttle payload requirements, on board requirements, data rates, and shuttle interfaces, and publications of conferences, seminars, and workshops will be covered in this area.

A79-10576 **Space Simulation Conference, 10th, Bethesda, Md., October 16-18, 1978, Technical Papers.** Conference sponsored by AIAA, IES, and ASTM. New York, American Institute of Aeronautics and Astronautics, Inc., 1978. 178 p. Members, $17.; nonmembers, $22.

Papers are presented on Jupiter entry simulation using a high-performance arc heater, orbital construction support equipment for the Manned Remote Work Station, verification of the Shuttle/Payload Contamination Evaluation computer program, estimation of particulates in the vicinity of a Shuttle Orbiter due to meteoroid impact, and experimental evaluation of a unique vane-radiometer for use in solar simulation tests. Also considered are the simulation of UV irradiation effects on candidate Spacelab thermal control coatings, the simulation of Skylab orbit decay and attitude dynamics, Space Shuttle entry thermal testing techniques, and ground-based simulation of Spacelab life sciences experiments. B.J.

A79-11324 * **United State space programs - Present and planned.** R. A. Frosch (NASA, Washington, D.C.). *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct. 1-8, 1978, Paper 78-301.* 12 p.

The U.S. space program is considered with reference to the benefits derived by the public. Missions are divided into three categories: the use of near-earth space for remote sensing, communications, and other purposes directly beneficial to human welfare; the scientific exploration of the solar system and observation of the universe as part of the continuing effort to understand the place of earth and man in the cosmos; and the investigation of the sun-earth relationships which are basic to the terrestrial biosphere. Individual projects are described, and it is suggested that the future of space technology in 1978 is comparable to the future of aviation in 1924. M.L.

A79-11566 **The Shuttle attached remote manipulator program - A status review.** J. MacNaughton (Spar Aerospace Products, Ltd., Toronto, Canada). *American Astronautical Society and Deutsche Gesellschaft fur Luft- und Raumfahrt, Goddard Memorial Symposium, 16th, Washington, D.C., Mar. 8-10, 1978, AAS Paper 78-049.* 23 p.

The Shuttle remote manipulator system (RMS) is described with attention to Canada's role in its development. The RMS uses a manipulator arm with six degrees of freedom; this arm is operated by a payload specialist located in the aft area of the Shuttle's crew compartment. RMS topics discussed include the arm subsystem, baseline payloads, performance requirements, and control modes. The contractor and subcontractors are indicated. M.L.

A79-11852 **Spacecraft charging at geosynchronous orbit - generalized solution for eclipse passage.** H. B. Garrett and A. G. Rubin (USAF Geophysics Laboratory, Bedford, Mass.). *Geophysical Research Letters*, vol. 5, Oct. 1978, p. 865-868. 11 refs.

Rapid variations in spacecraft potential are observed on entry and exit from the earth's shadow. Generalized equations, based on elementary plasma probe theory, are developed which make quantitative estimates of the spacecraft potential as a function of satellite position in the earth's penumbra and are compared with data from the ATS-5 and ATS-6 geosynchronous satellites. The agreement between the observations and the predictions results from the approximate constancy of the ratio of the ambient ion to electron current during injection events. Due to the significant size and shape differences of the ATS-5 and ATS-6 satellites, the results are applicable in many space physics situations such as estimating the effects of electron beams on satellite potential and of spacecraft charging on very large space structures. (Author)

A79-16126 **Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings.** Congress sponsored by the Canaveral Council of Technical Societies. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978. 216 p. $25.

Papers are presented on the current status of space transportation, technology transfer from Federal laboratories to the public and private sectors, solar energy utilization, and energy management and conservation. Consideration is also given to future space programs (e.g., space industrialization and advanced space transportation systems), NASA technology utilization programs, and advanced space technology (e.g., space power systems and large-area space systems). B.J.

A79-16137 **Economic opportunities of space enterprise in the next decades.** K. P. Heiss (Exxon Inc., Princeton, N.J.). In: Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978. p. 4-14 to 4-21.

The successful deployment of the Space Shuttle System in the early 1980s will enable the redirection of the U.S. Space Program from an emphasis on means to an emphasis on the scientific and economic application goals of space technology. This redirection effort is discussed with reference to four topics: (1) the development of global information systems, (2) applications of large space structures, (3) space as an energy base for mankind, and (4) likely phases of space application development. B.J.

A79-16145 * **A technology program for large area space systems.** A. Guastaferro (NASA, Langley Research Center, Hampton, Va.) and L. M. Jenkins (NASA, Johnson Space Center, Spacecraft Design Div., Houston, Tex.). In: Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978. p. 6-42 to 6-53.

The large space systems technology program (LSST) is discussed. The purpose of LSST is to define and develop technology for large space systems and associated subsystems required for projected NASA space missions. Goals involving structural concepts and supporting technology are surveyed. The application of LSST to the design of the solar power satellite is considered. M.L.

A79-16146 **Future space transportation systems.** G. M. Hanby (Rockwell International Corp., Space Div., Seal Beach, Calif.). *Canaveral Council of Technical Societies, Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Paper.* 11 p. 14 refs.

Potential scenarios (including military missions) driving space transportation system requirements in the future are presented. Of these scenarios, the one with the most impact on transportation requirements and concepts contains the operational satellite power system (SPS) program. The SPS program has a significant impact on the evolution of the Space Shuttle through 1995, on new launch vehicles beyond 1995, and on new orbit transfer vehicles (OTV's). Transportation options for earth to low-orbit and orbit transfer vehicles potentially meeting the future requirements are described. Comparisons of the capabilities of these transportation concepts to meet future requirements are made, and the major technology areas needing development are described. (Author)

A79-16973 * **Space Shuttle - The next twenty-five years.** S. Z. Rubenstein (Rockwell International Corp., Space Systems Group, Downey, Calif.). In: Diamond jubilee of powered flight: The evolution of aircraft design. Proceedings of the Conference, Dayton, Ohio, December 14, 15, 1978. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 149-152. (AIAA 78-3016)

After a brief description of the Space Shuttle vehicle, the Shuttle mission profile, small self-contained payloads, and the overall Space Transportation System, the paper highlights future applications of the Shuttle. Consideration is given to expanded experimentation in space, the extended-duration Orbiter, the assembly of large structures in orbit, and the nature of complexity inversion. B.J.

A79-17124 **Space Shuttle - America's wings to the future.** M. H. Kaplan (Pennsylvania State University, State College, Pa.). Fallbrook, Calif., Aero Publishers, Inc., 1978. 215 p. $14.95.

This book describes the Space Shuttle program, its scope, goals, status, future, and benefits in a style addressed to the general public. The discussion covers the development of the concept of the Space Transportation System, the Shuttle launch, operations in space, and return from orbit and landing. Considerable emphasis is placed on the benefits for mankind that may result from the Space Transportation System. Projects made possible by a Shuttle-type system are discussed, including solar power stations in space, giant orbiting antenna systems for communications, and space colonies. Possibilities for a new generation of Shuttles are discussed. P.T.H.

A79-17275 * **Overview of future programs - USA.** R. F. Freitag (NASA Office of Space Transportation Systems, Washington, D.C.). *Canaveral Council of Technical Societies, Space Congress, 15th, Cocoa Beach, Fla., Apr. 26-28, 1978, Paper.* 67 p.

An overview of U.S. manned space flight is presented and recent advanced studies are considered. In connection with long-range mission planning, studies are being conducted of future space systems, space vehicles, and space operations. An early Space Construction Base is being studied for launch in 1985 and associated geosynchronous operations are projected for 1987. The Space Construction Base is envisioned as a facility for erecting large structures in space, for basing Manned Orbital Transfer Vehicles that operate between low earth orbit and geosynchronous orbit, and for the conduct of industrial operations and scientific experiments in space. Ways and means for erecting large structures in space are examined. One particular plan involves the development of the technology to demonstrate the capabilities of a solar power station to translate solar energy to electrical energy for use on commercial power stations on earth. Advanced transportation is also being studied, particularly for needs that complement the Shuttle. The use of the Shuttle System as a Heavy Lift Launch Vehicle to place large-diameter payloads up to 200,000 pounds in weight is also being explored. G.R.

A79-20765 **Using space - Today and tomorrow. Proceedings of the Twenty-eighth International Astronautical Congress, Prague, Czechoslovakia, September 25-October 1, 1977. Volume 1 - Space Based Industry Symposium. Volume 2 - Communications Satellite Symposium.** Congress sponsored by the International Astronautical Federation. Edited by L. G. Napolitano (Napoli, Universita, Naples, Italy). Oxford, Pergamon Press, Ltd., 1978. Volume 1, 289 p., vol. 2, 166 p. Price of vol. 1, $40.; vol. 2, $30.

The papers report on various on-going and planned projects in the utilization of space. Topics discussed include gaseous-fuel nuclear reaction research for multimegawatt power in space, planning for large construction projects in space, possible planetary missions using the Ariane launcher, technological experiments on board Salyut-5, new developments in microwave remote sensing, the Ekran satellite TV broadcasting system, and design factors affecting communications satellite lifetime. P.T.H.

A79-21274 * **Space Shuttle - Providing for man's future in space.** G. B. Merrick (Rockwell International Corp., Space Systems Group, Downey, Calif.). *American Astronautical Society, Anniversary Conference, 25th, Houston, Tex., Oct. 30-Nov. 2, 1978, Paper 78-178.* 10 p.

Structural design, missions, and costs of the Space Shuttle are reviewed with emphasis on the capabilities of the spacecraft and its long-range benefits in the field of space industrialization. Projected developments in the area of the Space Transportation System going beyond the capabilities of the Shuttle, such as expendable solar power modules using thermal and direct conversion cycles, and large space structure assembly are discussed. Capabilities outlook for space missions for the remainder of the century are analyzed in terms of federal fiscal outlays stressing the importance of continuous space research. A.A.

A79-23511 * **Space environmental interactions with spacecraft surfaces.** N. J. Stevens (NASA Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0386.* 25 p. 47 refs.

The employment of large structures in space, which would be necessary in connection with a number of space missions and space activities currently being contemplated, might involve special problems as a result of the interactions of the structures with the charged particle environment. Such interactions would be particularly significant in the case of high operational voltages. A review is presented of possible interactions between spacecraft surfaces and charged particle environments. The categories of spacecraft environmental interactions are examined and a description of spacecraft charging interactions is presented. The status of charging investigation is considered, taking into account the environment, aspects of analytical modeling, materials characterization, materials development, space flight experiments, and design guidelines. High voltage surface plasma interactions are also investigated. G.R.

A79-24722 * **Large aperture pattern measurement facility.** C. E. Kirchhoff (Martin Marietta Aerospace, Denver, Colo.). In: Antenna Applications Symposium, Urbana, Ill., September 20-22, 1978, Proceedings. Urbana, Ill., University of Illinois, 1978. 25 p.

A facility is described which was sized to test antennas up to the maximum size capability of the cargo bay of the Space Shuttle. The pattern data will be obtained by first measuring the antenna near-field phase and amplitude and then using an FFT to transform the phase and amplitude to the far-field pattern. Since the facility is being constructed to operate up to 12 GHz, the mechanical tolerances on the near field probe motion are quite severe. The probe is translated over 40 ft of linear travel and the antenna is translated over 40 ft under the probe to yield an effective scan area of 40 ft by 40 ft. The designs of the probe and antenna transport mechanisms which will meet the severe tolerances are described along with the electronics component of the facility. B.J.

A79-25574 **Component ownership on large space structures.** D. D. Smith. *Satellite Communications*, vol. 3, Feb. 1979, p. 39, 40, 42.

In June 1977 an institutional plan for multipurpose space platforms was suggested to the U.S. Congress. The Component Ownership proposition, designed to facilitate participation by all interested and qualified entities in future large space structures, is discussed. The types of ownership are classified into four categories, with a particular entity able to belong to one or more categories (or groups) at a single time. Group A encompasses frame ownership and operation, with the other groups involving module ownership and operation, service providers and direct module users, and end users respectively. The Group A entity is expected to lease space on-board the platform at a uniform and equitable rate to all Group B entities,

whereas the latter would lease module capacity to users either on a unit of measure or on a proportion of module basis. Group C entities would have the option to be Category B owners, with the Group D entities expected to provide the revenue base supporting the systems and entities involved with the platform. A.A.

A79-28000 **Cargo spaceships after Shuttle.** D. Baker. *Flight International*, vol. 115, Mar. 17, 1979, p. 836-838.

Unmanned Space Shuttle derivatives and new heavy-lift launch vehicles proposed to deliver cargo to space for the construction of large space structures are discussed. It is suggested that the best way to meet future payload requirements would be to develop a Space Shuttle derivative for smaller payloads and an all new launcher for larger ones. NASA has found that launchers carrying payloads of from 60 to 135 tons could be derived from the present Space Shuttle (capacity 29.5 tons). Modifications would consist of replacing the Orbiter by an expendable cylindrical payload container, using a recoverable pod for three Space Shuttle main engines and using two or four solid rocket boosters. Liquid reusable boosters have been proposed as well, and while their use would increase payload capacity and reduce launch costs, the development costs are high. A vehicle which could carry from 230 to 270 tons of payload and consisting of two recoverable stages having ballistic trajectories is also presented. A.L.W.

A79-30487 * **Space transportation, satellite services, and space platforms.** J. M. Dishon (NASA, Office of Space Transportation Systems, Washington, D.C.). *Astronautics and Aeronautics*, vol. 17, Apr. 1979, p. 42-51, 67. 9 refs.

The paper takes a preview of the progressive development of vehicles for space transportation, satellite services, and orbital platforms. A low-thrust upper stage of either the ion engine or chemical type will be developed to transport large spacecraft and space platforms to and from GEO. The multimission spacecraft, space telescope, and other scientific platforms will require orbital serves going beyond that provided by the Shuttle's remote manipulator system, and plans call for extravehicular activity tools, improved remote manipulators, and a remote manned work station (the cherry picker). P.T.H.

N79-10081*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SHUTTLE CREW STATION ASTRONAUT INTERFACES
George C. Franklin. *In* NASA. Langley Res. Center, Large Space Systems Technol., Vol. 1, 1978, p. 71-140.

Avail: NTIS HC A23/MF A01; CSCL 22B

The current shuttle orbiter configuration and its crew module and payload bay accomodations for work and off duty activities are described. The capability of the remote manipulator system and provisions to support extravehicular activities are examined with emphasis on flight crew activities for orbital flight tests and for early operational space transportation system flights. Facilities used to verify crew interfaces are also described. A.R.H.

N79-10119* National Aeronautics and Space Administration, Washington, D. C.
PROGRESS SATELLITE: AN AUTOMATIC CARGO SPACECRAFT
N. Novikov. Oct. 1978. 10 p. Transl. into ENGLISH from Aviat. Kosmonaut. (Moscow), no. 7, Jul. 1978, p. 36-37. Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-3198)
(NASA-TM-75575) Copyright. Avail: NTIS HC A02/MF A01; CSCL 22B

The requirement for resupplying long term orbital space stations is discussed. The operation of Progress (an unmanned automatic resupply spacecraft) is described. It concludes that the development of Progress is a major contribution of Soviet science to domestic and world aeronautics. J.S.

N79-10122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FUTURE ORBITAL POWER SYSTEMS TECHNOLOGY REQUIREMENTS
Sep. 1978. 195 p. refs. Symp. held at Cleveland, 31 May - 1 Jun. 1978.
(NASA-CP-2058; E-9713) Avail: NTIS HC A09/MF A01; CSCL 10A

NASA is actively involved in program planning for missions requiring several orders of magnitude more energy than in the past. Therefore, a two-day symposium was held to review the technology requirements for future orbital power systems. The purpose of the meeting was to give leaders from government and industry a broad view of current government supported technology efforts and future program plans in space power. It provided a forum for discussion, through workshops, to comment on current and planned programs and to identify opportunities for technology investment. Several papers are presented to review the technology status and the planned programs.

N79-10123*# National Aeronautics and Space Administration, Washington, D. C.
OAST SPACE POWER TECHNOLOGY PROGRAM
Jerome P. Mullin. *In* NASA. Lewis Res. Center, Future Orbital Power Systems Technol. Requirements, Sep. 1978, p. 1-16.

Avail: NTIS HC A09/MF A01; CSCL 10A

The current research and technology (R and T) base program is first described, then special attention is directed toward outlining a new system technology specifically oriented toward providing the utility power plant technology base for semi-permanent earth orbital facilities expected to be needed in the mid- to late 1980's. The R and T program involves five areas of research: (1) photovoltaic energy conversion; (2) chemical energy conversion and storage; (3) thermal-to-electric conversion; (4) environment interactions; and (5) power systems management and distribution. The general objectives and planned direction of efforts in each of these areas is summarized. G.Y.

N79-10126*# National Aeronautics and Space Administration, Washington, D. C.
OVERVIEW OF OFFICE OF SPACE TRANSPORTATION SYSTEMS FUTURE PLANNING
Melvyn Savage and J. William Haughey. *In* NASA. Lewis Res. Center, Future Orbital Power Systems Technol. Requirements, Sep. 1978, p. 71-92.

Avail: NTIS HC A09/MF A01; CSCL 10A

The Space Transportation Systems key milestones as well as the future planning of the Office of Space Transportation Systems are summarized. A brief description and identification of candidate new starts with target development initiation and first flight dates are included. G.Y.

N79-10138*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
JSC SPACE BASE POWER MODULE STUDIES
Jerry W. Craig. *In* NASA. Lewis Res. Center, Future Orbital Power Systems Technol. Requirements, Sep. 1978, p. 247-264.

Avail: NTIS HC A09/MF A01; CSCL 10A

Users of the Orbiter/Spacelab combination will require both higher electrical power and longer duration than is available with the current baseline system. Present Orbiter/Spacelab mission capability is primarily constrained by the hydrogen and oxygen available to generate power in the Orbiter fuel cells. It is also necessary to assure that considerable attitude or point flexibility is retained to assure efficient operation of the Orbiter radiator cooling system. Beyond these early limitations, it is foreseen that orbital operations will eventually need even greater quantities of the basic space utilities: electrical power, heat rejection, and attitude control. Such operations, forecasted for the mid to late

1980's, will be best accommodated by a module stored on orbit that can furnish these to a docked Orbiter/Spacelab or other vehicles. The Orbital Service Module concept to provide for these services is presented. G.Y.

N79-10142*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
SOLAR ARRAY WORKSHOP
Paul Goldsmith *In* NASA. Lewis Res. Center Future Orbital Power Systems Technol. Requirements Sep. 1978 p 279-282

Avail: NTIS HC A09/MF A01 CSCL 10A

The solar workshop began with a review of the needs and objectives in this area as presented by the various government representatives during the preceding sessions. The major problem noted with respect to needs was the potentially conflicting requirements of low cost and low weight. Since the importance of weight and cost and relationship between them are strongly mission dependent, the workshop concluded that the requirements of military missions in synchronous orbit could be quite different from the requirements of NASA low-orbit missions and that an assignment of specific technology deficiencies could only be related to specific mission classes. G.Y.

N79-12132# Air Force Geophysics Lab., Hanscom AFB, Mass.
SPACECRAFT CHARGING AT GEOSYNCHRONOUS ORBIT: SOLUTION FOR ECLIPSE PASSAGE. Air Force Surveys in Geophysics
Henry Berry Garrett and Allen G. Rubin 15 May 1978 17 p refs
(AF Proj. 7661)
(AD-A058983; AFGL-TR-78-0122; AFGL-AFSG-389) Avail: NTIS HC A02/MF A01 CSCL 20/3

Rapid variations in spacecraft potential are observed on entry and exit from the earth's shadow. Generalized equations, based on elementary plasma probe theory, are developed which make quantitative estimates of these potentials as a function of satellite position in the earth's penumbra, and are compared with data from the ATS-5 and ATS-6 geosynchronous satellites. The agreement between the observations and the predictions results from the approximate constancy of the ratio of the ambient ion to electron current during injection events. Due to the significant size and shape differences of the ATS-5 and ATS-6 satellites, the results are applicable in many space physics situations such as estimating the effects of electron beams on satellite potential and of spacecraft charging on very large space structures.
Author (GRA)

N79-14140*# General Electric Co., Philadelphia, Pa.
INDUSTRY/GOVERNMENT SEMINAR ON LARGE SPACE SYSTEMS TECHNOLOGY: EXECUTIVE SUMMARY. Final Report
Sinclaire M. Scala Dec. 1978 21 p refs
(Contract NAS1-9100)
(NASA-CR-2964) Avail: NTIS HC A02/MF A01 CSCL 22B

The critical technology developments which the participating experts recommend as being required to support the early generation large space systems envisioned as space missions during the years 1985-2000 are summarized. J.M.S.

N79-15105# Committee on Commerce, Science, and Transportation (U.S. Senate)
SYMPOSIUM ON THE FUTURE OF SPACE SCIENCE AND SPACE APPLICATIONS
Washington GPO 1978 114 p refs Hearing before the Subcomm. on Sci., Technol., and Space of the Comm. on Commerce, Sci., and Transportation, 95th Congr., 2d Sess., 7 Feb. 1978
(GPO-22-878) Avail: Subcomm. on Sci., Technol., and Space

Current and projected uses of space technology and sciences to meet human needs on Earth and in space are discussed. Factors influencing mission priorities are considered as well as methods for cost/benefit analyses.

N79-15110# ECON, Inc., Princeton, N.J.
STATEMENT OF DOCTOR KLAUS HEISS, PRESIDENT, ECON, INCORPORATED, PRINCETON, NEW JERSEY
Klaus Heiss *In* Comm. on Commerce, Sci., and Transportation (U.S. Senate) Symp. on the Future of Space Sci. and Space Appl. 1978 p 40-55 refs

Avail: Subcomm. on Sci., Technol., and Space

The economic self-interest of the United States over a horizon broader than the next 20 years will lead ultimately to some exciting adventures including establishments of space energy bases and space habitats. The time horizon is to the year 2075. At this juncture of the U.S. space program, a major opportunity exits to give a new impetus to space applications and sciences for the next two decades. This opportunity involves a redirection of the funding of space programs from an emphasis on means (rocket systems and space transportation systems) to an emphasis on the goals of space ventures in applications, sciences, and long term in-orbit activities by man. Four transfer application themes discussed include: global information systems, large space structure capability, space as an energy base, phases of space industrialization, and space habitation. Cost benefits and funding requirements for these ventures are projected. A.R.H.

N79-15113*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 1: SUMMARY REPORT. 1: INTRODUCTION. 2: GENERAL OBSERVATIONS AND SOME KEY FINDINGS. 3: FOLLOW-ON ACTIVITY. QUICK-LOOK COMMENTS AND WORKING PAPERS
1978 77 p Workshop held at Langley Station, Va., 26-30 Apr. 1978 17 Vol.
(NASA-TM-80001) Avail: NTIS HC A05/MF A01 CSCL 22A

The Outlook for Space Study, consideration of National needs and OAST technology goals were factors in the selection of the following themes for candidate technical initiative and supporting program plans: space power station, search for extraterrestrial life, industrialization of space, global service station, exploration of the solar system, and advanced space transportation system. An overview is presented of the Space Theme Workshop activities in developing technology needs, program requirements, and proposed plans in support of each theme. The unedited working papers used by team members are included. A.R.H.

N79-15115*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 2: THEME SUMMARY. 2: SPACE INDUSTRIALIZATION (NO. 8). A. THEME STATEMENT. B. 26 APRIL 1978 PRESENTATION. C. SUMMARY STATEMENT. D. INITIATIVE ACTION (FORM 6)
1978 30 p Workshop held at Langley Station, Va., 26-30 Apr. 1978 17 Vol.
(NASA-TM-80003) Avail: NTIS HC A03/MF A01 CSCL 22A

Enabling technology needs and other requirements to support space industrialization include: large space structures, fabrication and joining processes, single stage to orbit and heavy lift launch vehicles, nuclear and solar space power systems, robotics, manipulators, and teleoperators, biotechnology in space, artificial gravity, the utilization of lunar materials for construction, and the extraction of oxygen and metals from lunar resources. New initiatives (FY 1978) directly supportive or partly related to space industrialization are listed. A.R.H.

N79-15119*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 2: THEME SUMMARY. 6: ADVANCED TRANSPORTATION SYSTEMS. A. THEME STATEMENT. B. 26 APRIL 1978 PRESENTATION. C. THEME SUMMARY. D. INITIATIVE ACTIONS
1978 44 p Workshop held at Langley Station, Va., 26-30 Apr. 1978 17 Vol.
(NASA-TM-80007) Avail: NTIS HC A02/MF A01 CSCL 22A

Technology requirements for an integrated space transportation system capability which will allow the nation to use space efficiently, reliably, and routinely in the years between 1985 and 2000 with a significant return on invested resources will build on the currently defined space transportation system using shuttle, the IUS, and the advanced upper stage such as the solar electric propulsion system. Contributing technologies should include those which support (1) total reusability with minimal refurbishment, (2) responsiveness to high launch rate requirements when operation and energy are the predominant recurring costs, and (3) maximum flexibility in operation between earth and LEO and between LEO and GEO. Initiatives undertaken to advance the heavy lift to launch vehicles, single stage to orbit vehicles, and orbit transfer vehicles are listed. A.R.H.

N79-15129*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OAST SPACE THEME WORKSHOP. VOLUME 4: R AND T BASE SUMMARY. A: APRIL 26, 1976, PRESENTATION. B: SUMMARY STATEMENT
1976. 30 p. Workshop held at Langley Station, Va., 26-30 Apr. 1976. 17 Vol.
(NASA-TM-80017) Avail: NTIS. HC A03/MF A01. CSCL 22A.

The research and technology base program was examined to determine those tasks which either enabled or enhanced a theme and should be incorporated into that theme, and to identify new and promising R&T candidates which should be incorporated into the R&T base to meet essential long range space technology goals not addressed by the various themes. Candidates in the ongoing tasks category generally reflect the reorientation or pursuit of an ongoing RTOP on specific theme objectives, primarily involving the development and ground testing of new technology components and systems. Thirty-eight recommended candidate tasks are listed. A.R.H.

N79-15150*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE ENVIRONMENTAL INTERACTIONS WITH SPACECRAFT SURFACES
John N. Stevens. 1979. 23 p. refs. Presented at 17th Aerospace Sci. Meeting, New Orleans, La., 15-17 Jan. 1979. Sponsored by AIAA.
(NASA-TM-79016; E-9805) Avail: NTIS. HC A02/MF A01. CSCL 22B.

Environmental interactions are defined as the response of spacecraft surfaces to the charged-particle environment. These interactions are divided into two broad categories: spacecraft passive, in which the environment acts on the surfaces and spacecraft active, in which the spacecraft or a system on the spacecraft causes the interaction. The principal spacecraft passive interaction of concern is the spacecraft charging phenomenon. The spacecraft active category introduces the concept of interactions with the thermal plasma environment and Earth's magnetic field, which are important at all altitudes and must be considered the designs of proposed large space structures and space power systems. The status of the spacecraft charging investigations is reviewed along with the spacecraft active interactions. J.M.S.

N79-15815# Committee on Science and Technology (U.S. House).
UNITED STATES CIVILIAN SPACE PROGRAMS: AN OVERVIEW
Marcia S. Smith, George N. Chatham, Christopher H. Dodge, Barbara A. Luxenberg, Lori H. Rat..gh, and Charles S. Sheldon, II. Washington: GPO, 1979. 180 p. refs. Rept. for Subcomm. on Space Sci. and Ap,.ications of the Comm. on Sci. and Technol., 95th Congr., 2d Sess., Dec. 1978. Prepared by the Library of Congr., Congressional Res. Service.
(GPO-35-823) Avail: SOD HC.

An overview of NASA's history and its relationship to U.S. space policy is presented as well as a synopsis of the achievements and benefits derived from a many-faceted nonmilitary space program. Issues identified for congressional consideration of specific elements of a cohesive space policy relate to: (1) NASA as an organization, (2) NASA centers and facilities, (3) launch vehicles and propulsion, (4) applications satellites, (5) NASA tracking stations and the TDRSS, (6) space shuttle, (7) space sciences, (8) space life sciences, (9) materials processing in space, (10) international space programs, (11) domestic technology utilization, and (12) NASA university support. A.R.H.

N79-21117*# National Aeronautics and Space Administration, Washington, D.C.
NASA FACTS. AN EDUCATIONAL PUBLICATION OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. SPACE SHUTTLE
[1979]. 8 p.
(NASA-TM-79955; NF-79/6-77) Avail: NTIS. MF A01; SOD HC. CSCL 22B.

The versatility of space shuttle, its heat shieldings, principal components, and facilities for various operations are described as well as the accomodations for the spacecrew and experiments. The capabilities of an improved space suit and a personal rescue enclosure containing life support and communication systems are highlighted. A typical mission is described. A.R.H.

N79-21352*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE 12TH AEROSPACE MECHANISMS SYMPOSIUM
Apr. 1979. 241 p. refs. Symp. held at Moffett Field, Calif., 27-28 Apr. 1978; sponsored in part by NASA, Calif. Inst. of Tech. and Lockheed.
(NASA-CP-2080; A-7737) Avail: NTIS. HC A11/MF A01. CSCL 20K.

Mechanisms developed for various aerospace applications are discussed. Specific topics covered include boom release mechanisms, separation on space shuttle orbiter/Boeing 747 aircraft, payload handling, spaceborne platform support, and deployment of spaceborne antennas and telescopes.

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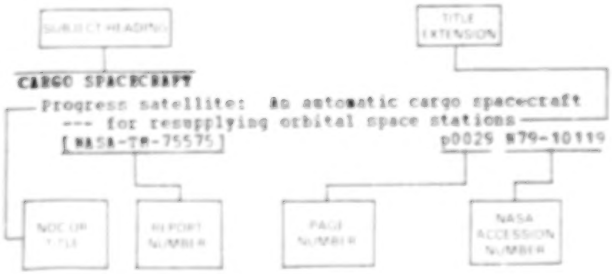

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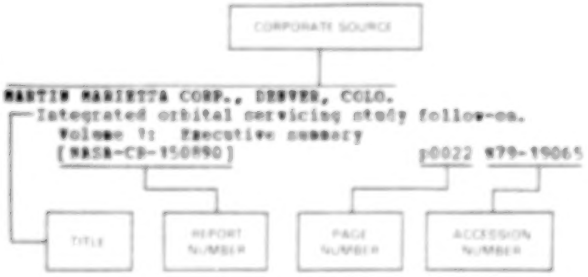

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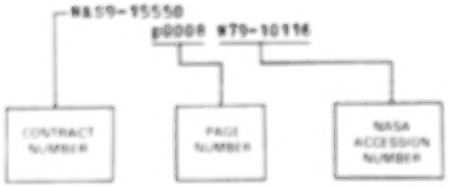

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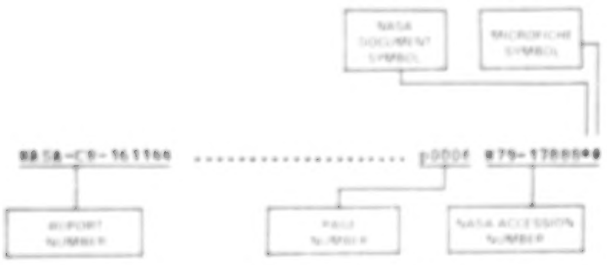

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